MOLLUSCA OF THE SOUTHWESTERN STATES, VII: THE DRAGOON, MULE, SANTA RITA, BABOQUIVARI, AND TUCSON RANGES, ARIZONA.

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This paper and the preceding one (VI) contain the account of mollusks collected in course of our explorations in 1910, from the middle of August to the middle of October. The forms obtained in the Santa Catalina Mountains will be described in connection with the collections made there by one of us (Ferriss) in 1913. We were ably assisted in the field by Mr. L. E. Daniels.[1] Besides the ranges enumerated in the title, some account is given of several minor hill groups, all in the region south of the Southern Pacific Railroad. While this paper, with those already published on the Chiricahua and Huachuca Ranges, is monographic for the mollusks of Arizona south of the Southern Pacific, yet the field is far from exhausted. Our work is a reconnaissance rather than a complete malacological survey. Further species will reward search in the southwestern end and outliers of the Chiricahuas, the southern Dragoons, the Whetstone Range, and the mountains around and south of Tombstone. Further west we have explored only small middle sections of the Santa Rita and Baboquivari Ranges. Many hill and mountain groups between Tucson and Nogales remain untouched, most of them doubtless inhabited by endemic species of Sonorella. In the nearly waterless region westward between the Baboquivari Range and the Colorado River, almost nothing has been done aside from some account of the snails of the Comobabi Mountains, which we are now giving.

Going westward in southern Arizona from the eastern limit of the State, the general level falls and the mountains become lower and smaller. There is a gradual elimination of snails requiring a reasonable degree of humidity. *Ashmunella* and *Oreohelix* extend west to the Huachucas. Beyond that range they disappear. The small shells also abruptly diminish in number of genera and species, by

[1] We are indebted to Mr. J. C. Blumer, of Tucson, for several species from the Comobabi and Cababi Mountains, which we did not visit.

elimination of the Transition Zone forms. *Holospira*, too, becomes rare. In the Santa Cruz River Valley it is known by one species—at the present time, one specimen; and none are known from further west. The spread of this genus is not controlled by humidity. It lives in the driest and hottest situations, often at low elevations, but it is confined to limestone tracts, and limited by volcanic or metamorphic rock. The mountains westward, in the region under consideration, are mainly volcanic, and the stony tracts are therefore unsuitable for *Holospira*.

The progressive impoverishment of the fauna leaves, in the Santa Cruz Valley and westward, a few Lower Sonoran *Pupillidæ*, *Zonitidæ*, *Thysanophora* (*hornii*), and the true desert snail, *Sonorella*. *Sonorella* will live in the most arid places, where the rainfall does not exceed 5 or 6 inches, so long as there is abundant rock shelter and a certain amount of shade, such as the shadow of a cliff or a small bush. Northern slopes are preferred. In exploring a new mountain or hill in the really arid country one aims for the northern or northwestern slope under the highest crags. If coarse talus or rock "slides" are found, persistent quarrying should produce *Sonorella*. In less arid mountains, such as the Santa Ritas, the most productive collecting stations are in the deep, verdant canyons.

The exact location of collecting stations, and especially of type localities, which we attempt in these papers, may seem meticulous to many zoologists. In humid areas, or in dealing with less sedentary animals, such exactness would hardly be worth while; if a type locality is fixed within a few miles, it is near enough. But here we deal with a region of intense local differentiation and with creatures which are often confined within narrow bounds by physical conditions. The hunt is difficult and laborious. The colonies are often so small, the country so vast, that, without careful directions, one might make a season's campaign in the more complex ranges without relocating some former find which it might be important to investigate further. It is, moreover, important to show exactly what ground has been covered, in order that further exploration can be made to the best advantage, that the unexplored parts of the ranges may be gone over. In future it will be of interest to be able to trace the changes and fate of the smaller and more isolated colonies, such as that of *Sonorella eremita*, which covers an area of only a few square rods, many miles from any other snail colony. We suggest that future collectors continue our serial station numbers in each range, instead of beginning again at No. 1.

I. The Dragoon Mountains.

This range stands 25 or 30 miles west of the Chiricahua Mountains in Cochise County, Arizona. The well-known double-headed peak of Dos Cabezas is seen northeastward and the Whetstone Mountains westward, but the Dragoons are entirely isolated from other ranges. The Pearce mining district lies on the east side. To its proximity and the demand for mine timber the deforestation of the mountains is due. All of the timber was cut about 25 years ago, but the range, now forming the Dragoon Forest Reserve, shows good reproduction in places. At present the mountains are almost as bare as the Dos Cabezas.

The range is reached from Dragoon Summit, a station on the Southern Pacific R. R. at the northwestern foot of the mountains. North of the railroad the "Little Dragoons" form a low continuation of the range. There is a depression at Middle Pass (Middlemarch Canyon), where a road from Tombstone to Pearce crosses the range. We did not explore the southern half of the range, below Middlemarch, nor the Little Dragoons north of the railroad.

The mountains are formed of a complex of limestones and igneous rock, the granites forming wild labyrinths of narrow gorges abounding in cliffs and falls, separated by inaccessible crags and spires, which gave a refuge to the Apaches thirty or forty years ago. The limestones, forming a large part of the range, are accessible enough, though rather abrupt, and as usual they proved much more prolific of snails than the granitic and andesitic rocks.

The range was visited by us (Ferriss, Daniels and Pilsbry) in October, 1910. A week was spent in Tweed Canyon, where there is a small stream. The map (p. 366) showing collecting stations from Stations 7 and 8 northward was sketched from high points around Tweed Canyon and its northern amphitheatre. After Pilsbry had left, Ferriss and Daniels moved south to Middlemarch Canyon, and the stations (28–36) south of Station 8 are located by notes and a sketch made by them.[2]

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[2] The map is intended solely to show the positions of our collecting stations, many of which can probably be located exactly, and the others approximately, by the landmarks given. The contour lines merely show local relative elevation, not absolute altitude, and are not consistent on different parts of the map. The summit midway between Stations 5 and 12 on the northern ridge of the amphitheatre above Tweed Canyon is visible from the railroad at Dragoon Summit.

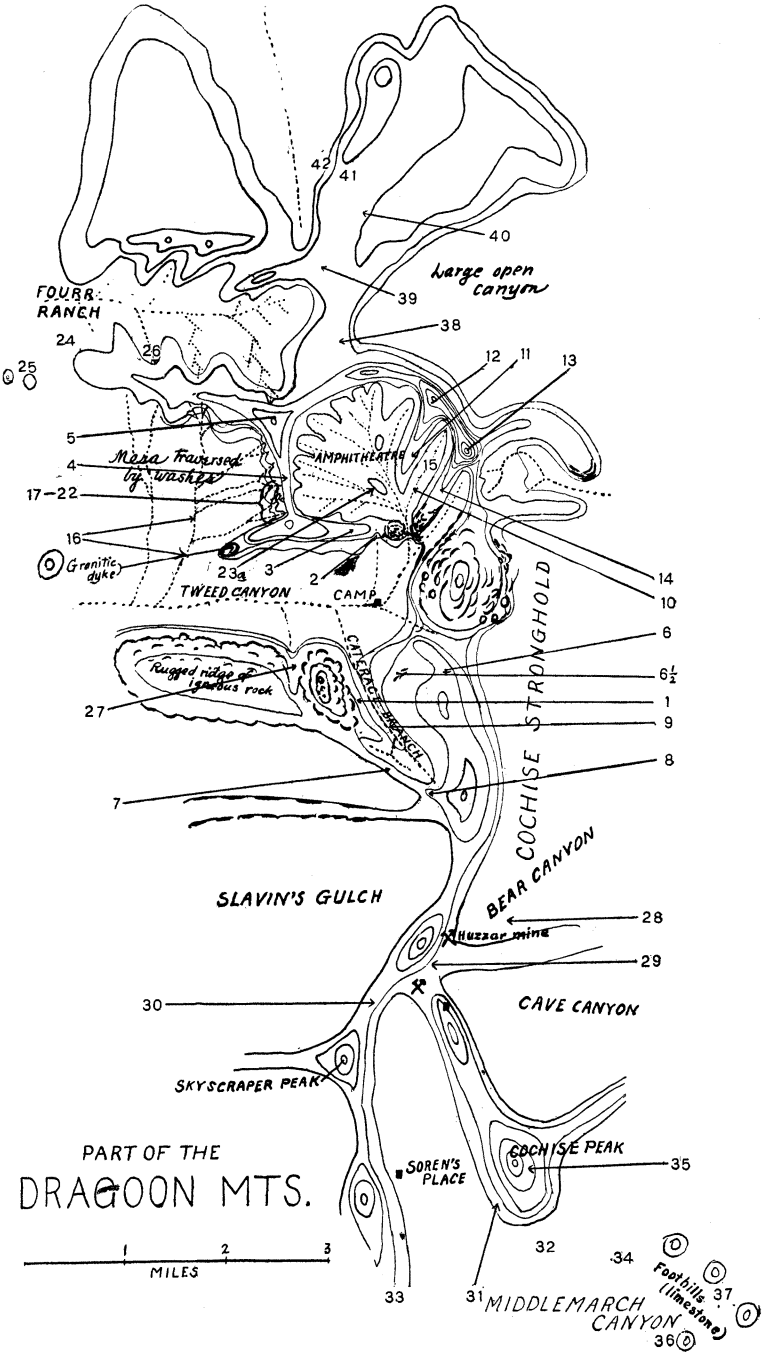

Fig. 1.—Collecting stations in the Dragoon Mountains.

The fauna of this small range is strongly individualized, since all of the Holospiras and larger Helices are very distinct from species of other ranges, even the Sonorellas having well-defined conchological features. Like the Huachucas, there is (or was) an *Oreohelix* of the *strigosa* group, but hairy forms and the *Radiocentrum* group are wanting. The minute shells are all species common to the Chiricahua, Huachuca and other larger ranges, but the Transition and Canadian Zone species are very sparsely represented by *Pyramidula cronkhitei*, *Cochlicopa lubrica* and *Vertigo coloradensis arizonensis* only. Otherwise the fauna is purely Lower Sonoran.

The collecting stations are as follows:

Station 1. Slide of heavy, angular rock on west side of cataract branch of Tweed Canyon, below the crags of this side.

Station 2. Near the foot of small ravine next west of the granite defile forming the outlet of the Tweed amphitheatre.

Station 3. Near and at top of ridge above Station 2.

Station 4. Rim of amphitheatre, western side.

Station 5. Immediately north of small peak at N. W. of amphitheatre.

Station 6. Crag about half way up mountain on east side of cataract branch, overlooking part of Cochise Stronghold.

Station 6½. West of Station 6.

Station 7. Limestone ridge at the head of Cataract Branch.

Station 8. Higher up on the same ridge eastward.

Station 9. East side of the rocky bed of Cataract Branch, near the foot of the (dry) "falls."

Station 10. Bottom of eastward ravine in Tweed amphitheatre.

Station 11. Part way up ridge northwest of 10.

Station 12. High peak at summit of preceding ridge.

Station 13. High peak southeast of 12.

Station 14. Middle of ridge running from 13 to mouth of amphitheatre.

Station 15. Near bottom of ravine north of 14, and further up than 10.

Station 16. Arroyo in mesa in the mouth of Tweed Canyon.

Station 17. Third small ravine west of the large granitic spur in Tweed Canyon.

Station 18. Above Station 17, and separated from it by granitic dyke about 50 yards wide.

Station 19. Below Station 17.

Stations 20–22. Second ravine from large granitic spur in Tweed Canyon.

Station 22*a*. Second ravine west from Station 2, lower part of mountain.

Station 23. Second ravine west from Station 2, near summit of ridge. This station and the preceding one were not visited by

Pilsbry and are not plotted on the map. They are believed to be east of the granitic spur (dyke) on the north side of Tweed Canyon.

Station 23*a*. Small hill in bottom of Tweed amphitheatre near an abandoned arrastra.

Station 24. Gully on mesa, running westward out of Fourr ranch.

Station 25. Foothill west of Fourr ranch.

Station 26. Gully at south fence of Fourr ranch.

Station 27. First ravine west of Cataract Branch in the igneous southern side of Tweed Canyon.

Station 28. Bear Gulch, half way down.

Station 29. Bear Gulch, near its head.

Station 30. Ridge west of Bear Gulch.

Stations 31, 32. East side of Soren Gulch.

Station 33. West side of Soren Gulch.

Station 34. Small limestone hill in Middlemarch Canyon.

Station 35. Cochise Peak.

Stations 36, 37. Small limestone hills eastward on mesa at mouth of Middlemarch Canyon.

Station 38. North side of north ridge of Tweed amphitheatre, $\frac{1}{4}$ mile west of Signal Peak.

Stations 39–42. Successive stations between the northern crest of Tweed amphitheatre and the northern foothills of the range.

HELICIDÆ.

Sonorella ferrissi Pilsbry, n. sp. Pl. VIII, figs. 3, 3*a*, 3*b*.

The shell is strongly depressed, umbilicate (the width of umbilicus contained six times in the diameter of the shell), rather solid; of a pale brown tint, between cinnamon and wood-brown, fading around the umbilicus, having broad white bands above and below the narrow chestnut-brown shoulder band and crossed by one or several whitish streaks, reminiscent of former peristomes. The surface is semimat. The initial one-fourth whorl is smooth; a brief stage of coarse radial wrinkles ensues, followed by fine, short, interrupted radial wrinkles, so short as to be papillæ near the upper suture, and sparse, short elevations, arranged in spiral, forwardly descending series. On the second whorl these elevations become distinct, rather regular papillæ, which persist, in some examples, upon the third whorl. The last whorl has fine striæ and microscopic wrinkling. The spire is but slightly convex. The whorls increase slowly, the last descends a little in front and is rounded at the periphery and base. The peristome expands very slightly in its lower half, and its edge has a rusty tint. It is thickened within by a rather wide but thin white callus, which shows as an opaque buff border behind the lip. The columellar termination is slightly dilated, and the parietal callus moderately thick in fully mature or old individuals.

Height 7, diam. 14.2 mm.; $4\frac{1}{2}$ whorls.

Genitalia (Plate XI, figs. 3, 3*a*).—The penis is somewhat slender, slightly shorter than the vagina, and a trifle longer than the epiphallus. It contains a cylindric papilla nearly as long as itself, transversely wrinkled in the distal third and rounded at the end (fig. 3*a*). The retractor muscle is inserted on the epiphallus near its base. *There is no flagellum.* Length of penis 4 mm.; penis-papilla 3+ mm.; penial retractor 6 mm.; epiphallus 3+ mm.; vagina $5\frac{1}{2}$ mm.

Dragoon Mountains, from the northern ridge of Tweed Canyon to the ridges facing the northern slope of the mountains; types No. 103,097, A. N. S. P., from Station 38. Also taken at Stations 3, 4, 5, 10, 12, 13, 14, 15, 21, 22, 38–41.

The shell in this extremely distinct species reminds one a little of *Trichodiscina.* There is no other *Sonorella* like it. The embryonic sculpture is a modification of the *hachitana* pattern. In the genitalia it resembles *S. bicipitis* of the Dos Cabezas range as much as anything. It is abundant in the northern part of the Dragoon Range, but Tweed Canyon apparently forms an impassable barrier to its spread southward.

We rarely found *Sonorella ferrissi* sealed to stones, forming small rings. Most living ones were seen loose under stones or in the earth, lying with the aperture up, like Eastern Helices, and sealed with a somewhat convex white epiphragm. It belongs exclusively to the limestone terrain.

Sonorella dragoonensis n. sp. Pl. VIII, figs. 1, 1*a*, 1*b*.

The shell is rather depressed, umbilicate (the umbilicus contained $6\frac{1}{2}$ times in diameter of the shell), thin, somewhat translucent, pale buffy brown, with whitish bands on both sides of a chestnut-brown band at the shoulder. The spire is low, conic, whorls $4\frac{2}{3}$, moderately convex. First one-third whorl smooth, followed by a brief stage of coarse radial wrinkles, continuing longest near the lower suture, and succeeded by papillæ and short, vermiculate radial wrinkles, interrupted by short wrinkles in a spiral direction, which on the lower part of the whorl bear epidermal bristles, beginning on the latter half of the first whorl, and continuing throughout the embryonic and neanic stages as far as the end of the third whorl. It is succeeded by an excessively minute vermiculate sculpture, which rapidly becomes fainter and disappears on the last two whorls, which are glossy and nearly smooth except for faint growth lines. Last whorl wide, descending in front. Aperture very oblique, round-oval. Peristome thin, very narrowly expanded throughout,

a little recurved below; the margins approaching, parietal callus short, thin except in old shells.

Alt. 11.25, diam. 19.5, alt. aperture 10.5, diam. 9.25 mm.
" 12 " 20.5, " " 11, " 9.25 "

Back dusky, tentacles dark, sole pale yellowish, with faint longitudinal lines, demarking the areas, near the tail.

Genitalia (Pl. XI, figs. 4, 4*a*, No. 103,093, from Station 29).—The penis is large, cylindric, encircled by a small muscular sheath at the contracted base, its retractor muscle inserted upon the apex of the penis and the base of the epiphallus. The walls of the penis are thin. Papilla (fig. 4*a*) nearly as long as the penis, stout, cylindric, having obliquely longitudinal corrugation near the end, the apex being obtusely conic with terminal pore. The flagellum is longer than usual. Epiphallus is about equal to the penis in length. The vagina is decidedly shorter than the penis. The duct of the spermatheca is very long.

Length of organs in mm.:

No. 103,093.—Penis, 10; epiphallus, 10; flagellum, 1.3; papilla, 8; vagina, 6; spermatheca and duct, 39.

No. 103,094.—Penis, 11; epiphallus, 9; flagellum, 1.3; papilla, 7.5; vagina, 7.

The jaw is highly arched, with five broad, unequal ribs.

Dragoon Mountains. Types from Station 28, Bear Canyon, No. 103,094, A. N. S. P., collected by Ferriss and Daniels, November, 1910. Also at Station 29, south of the Huzzar Mine, in the same vicinity.

This species is related to Dos Cabezas species by the position of the insertion of the penis-retractor, the cylindric penis-papilla and the short vagina. It differs from all of these in its very large and differently sculptured penis-papilla, and the thin shell, with rounded aperture and minute granulation and hairs on the neanic whorls, and a different pattern on the embryonic whorls. It is not closely related to any species of the ranges further west.

Other specimens, topotypes, from Station 28 measure:

Alt. 11, diam. 21 mm.
" 11.3, " 20.5 "
" 10.8, " 19 "
" 10.2, " 18.5 "

Specimens from Station 29 measure:

Alt. 10.9, diam. 20 mm.
" 10.3, " 18 "
" 10, " 20 "
" 9, " 17.3 "

Sonorella apache n. sp. Pl. VIII, figs. 2, 2*a*, 2*b*.

The shell is depressed, with low, conoidal spire, umbilicate (the width of umbilicus contained nearly 9 times in the diameter of the shell), extremely thin; mat isabella color above, paler below, glossy and diaphanous in the central half of the base, encircled by a narrow chestnut-brown band above the periphery. Whorls $4\frac{1}{2}$, the embryonic shell comprising $1\frac{1}{2}$; sculptured like that of *S. dragoonensis*. The neanic whorls are very minutely crinkled and closely set with short bristles in irregular oblique lines. About 110 of these bristles stand on one square millimeter, on the upper surface of the last whorl in front of the aperture. The bristles are rather delicate on the last whorl, and in cleaning the shell they are likely to be removed in large part. The last whorl is wide and descends rather deeply in front. The aperture is very oblique, subcircular. Peristome thin, the upper and outer margins very narrowly expanding, basal margin slightly recurved, columellar margin dilated, running forward. The ends of the peristome converge strongly, and are connected by a very thin, short, parietal film.

Alt. 10.25, diam. 16.8, width of umbilicus 1.9, aperture 8.5 x 9.7 mm.
" 10 " 17 mm.

Genitalia (Pl. XI, figs. 5 to 5*c*).—The penis is short and very thick, cylindric, obtuse at the ends, much shorter than the vagina. It has very thin walls, and is filled by a thick, fleshy papilla (fig. 5*a*). This is thick-walled with a rather large cavity having plicate walls so that it is star-shaped in section (fig. 5*b*). At the upper end of its cavity there is a short, conic nipple (fig. 5*c*); at the distal end of the papilla the cavity opens by a transverse slit. The retractor muscle of the penis is inserted on the epiphallus near the penis. The epiphallus passes imperceptibly into the vas deferens. *There is no flagellum.* The lower end of the vagina is swollen, having thick, fleshy walls. The organs measure as follows: Penis 7, penis-papilla 5, retractor muscle 8, vagina 11 mm.

Dragoon Mountains, the types from the southern or Cataract branch of Tweed Canyon, at Station 9, on the east side of the rocky bed near the foot of the "falls," No. 111,529. Also found at Station 1, a large slide of heavy, angular stone further north on the same branch, rather high on the west side of the ravine, under the great crag. A few dead shells were found at Station 27, in a gulch of the rugged south wall of Tweed Canyon, and at Station 10, on the eastern ridge of the amphitheatre of upper Tweed Canyon.

This species is somewhat related to *S. dragoonensis*, but differs by its smaller size, thinner shell, decidedly smaller umbilicus, and by having the last whorl densely hairy, the hairs extremely short and close. *S. apache* differs from *S. dragoonensis* rather conspicuously in soft anatomy. The penis is shorter with a differently constructed papilla; there is no flagellum; the vagina is much longer and is strongly swollen at the base. The anatomical characters of both have been examined in several specimens from different stations.

The delicately hairy periostracum will serve to separate *S. apache* from other species of the genus. It is an extremely distinct species.

Its home is among the great crags around Cochise Stronghold, a favorite resort of the Apaches. Station 10 is some miles northward of the other stations and at a somewhat greater elevation.

S. apache was found only in igneous or metamorphic rock, never in the limestone. It was not found sealed to the rock, nor were any white circles seen on the rocks it inhabits, thus differing from nearly all other Sonorellas collected by the authors.

Other specimens, from Station 1, measure:

Alt. 10.5, diam. 17.5 mm.
" 11, " 17 "
" 9.2, " 15 "
" 8.8, " 14 "

Station 1 is conspicuous from the hillside on the east side of the mouth of Cataract Branch, as a long, bare streak in the dense brush which clothes the slope below the crag at the west side, some distance up the ravine, and rather high on the side. One living shell and numerous "bones" were found by quarrying in the heavy rock of the slide. More living shells were taken at Station 9, the type colony.

The largest shell seen is a dead individual from Station 27, measuring 18.5 mm. in diameter.

Oreohelix strigosa var.

A young dead specimen was found at Station 2, under a stone, and two fragments of the last whorl at Station 13; both in the limestone region, but at very different elevations, Station 2 being only a hundred feet or so above the bed of Tweed Canyon, 13 on the highest peak of its rim. The largest fragment, half of the last whorl of an adult shell, has a diameter of 18.5 mm. It shows a slight peripheral angle, otherwise resembling *O. s. depressa* Ckll.

This Dragoon species seems from the fragments to be a more depressed shell than the extinct *Oreohelix* of the Florida Mountains, but it may be the same as the Huachucan race.

As we searched the range carefully for *Oreohelix* after finding one on the first day, it is probably extinct, not surviving the destruction of the woods. There remains a possibility that it may survive in some part of the mountains not covered by our collecting stations.

Thysanophora hornii (Gabb).

Stations 2, 3, 6, 6½, 10, 11, 18, all in the limestone region north of Tweed Canyon.

UROCOPTIDÆ.

Holospira is rarely if ever found on igneous or metamorphic rock; and as the Dragoons are traversed by many dykes, the limestone areas where Holospiras live are divided by tracts barren of these snails. This has resulted in the differentiation of several species which though variable do not intergrade, so far as we know. In the Hacheta Range the limestone is continuous, and while there has been a good deal of differentiation, the several extreme forms are connected by those intermediate in structure and location.

It must be admitted that our knowledge of the Dragoon Holospiras is fragmentary. The whole foothill region, where they abound, needs attention. They are easily found, and in large numbers.

Holospira danielsi n. sp. Pl. XIV, figs. 1 to 3*a*.

The shell is cylindric, the upper fourth (or third) tapering to the slightly mamillar, obtuse summit. Tilleul-buff, becoming darker towards the summit. Nearly 2½ embryonic whorls are smooth; then slightly retractive axial ribs appear, rather low and delicate on the first neanic whorl, after which they become strong, widely separated, oblique (retractive) on the conical portion, still more widely spaced and vertical on the cylindric portion of the shell, where the summits of the ribs are more or less irregular from breakage due to being in part hollow there. On the penultimate whorl there are 13 ribs (more or less). On the last half of the last whorl the ribs become closer (or many may be interposed). The whorls are rather strongly convex, the last one tapering downwards, being compressed below the periphery; base rimate but not perforated. The last fourth of the last whorl is somewhat straightened but not built forward beyond the level of the ventral face of the shell. Aperture rounded-ovate. Peristome narrowly expanded except at the upper outer angle, where it is simple and obtuse. The axis is rather slender, subequal except at the ends. In the last part of the penult and first part of the last whorl there is a strong, short, obtuse columellar lamella close to the base; a parietal lamella, much longer and usually strong (and frequently a smaller basal lamella).

Length 11.5, diam. 3.5 mm.; $12\frac{1}{2}$ whorls.

Dragoon Mountains, Cochise County, Arizona, from Tweed Canyon to the northern end of the range, on limestone, under stones, dead agaves, sotols, etc. Type locality Station No. 2, Tweed Canyon, No. 112,199, A. N. S. P.

They live on the most exposed, hottest slopes, often in great profusion, but are not found on the mesa, where *H. campestris* occurs.

This beautiful snail is very distinct from all of our species by its strong, rude, widely spaced ribs. One of the northwest Mexican Holospiras, *H. minima*, has the same type of sculpture, though less coarse than in the typical *H. danielsi*, which is the most strongly costate species known.

Like other Arizonian Holospiras, the internal lamellæ are variable, two or three (parietal and axial, or parietal, axial and basal) being developed. Otherwise the chief variation is in the number of ribs, and also in size.

Twenty specimens of the type lot, opened, taken at random, measure as follows:

Length	12,	diam.	3.6	mm.;	whorls	13;	lamellæ	2.
"	11.7,	"	3.7	"	"	13;	"	3.
"	11.5,	"	3.4	"	"	$12\frac{1}{2}$;	"	3.
"	11.3,	"	3.3	"	"	$12\frac{1}{2}$;	"	2.
"	11.2,	"	3.5	"	"	12;	"	3.
"	11.1,	"	3.3	"	"	12;	"	2.
"	11,	"	3.8	"	"	$11\frac{1}{2}$;	"	3.
"	11,	"	3.4	"	"	$12\frac{1}{2}$;	"	3.
"	11,	"	3.3	"	"	12;	"	3.
"	11,	"	3.3	"	"	$12\frac{1}{2}$;	"	2.
"	11,	"	3.3	"	"	12;	"	3.
"	10.8,	"	3.3	"	"	$11\frac{3}{4}$;	"	3.
"	10.5,	"	3.2	"	"	$12\frac{1}{2}$;	"	2.
"	10.2,	"	3.7	"	"	12;	"	2.
"	10.2,	"	3.3	"	"	12;	"	2.
"	10.2,	"	3.3	"	"	$12\frac{1}{2}$;	"	2.
"	10.2,	"	3.2	"	"	12;	"	2.
"	10.2,	"	3.1	"	"	12;	"	3.
"	10,	"	3.2	"	"	$11\frac{1}{2}$;	"	2.
"	9.7,	"	3.2	"	"	$11\frac{1}{2}$;	"	2.

The smallest shell noticed in the type lot measures 8.2 x 3.2 mm., with 10 whorls. The trilamellate shells are slightly outnumbered by those with two lamellæ, forming 45 per cent. in the lot measured; but this may be accidental. Three lamellæ predominate in the larger shells, two in the smaller.

The sculpture is less variable in this lot than in some others. Ten specimens, taken at random, have 10, 12, 12, 13, 13, 13, 15, 17, 17, 17 ribs on the penultimate whorl. These fairly represent the lot, so far as can be told without extensive counting. None counted have more than 17 ribs (see Pl. XIV, figs. 1, 1*a*, 1*b*).

Station 3 (summit of ridge above Station 2), but west of where the trail crosses ridge). Shells exactly like those of Station 2, but perhaps a little more variable in size, length 9 to 12½ mm. in extreme specimens.

Station 4 (summit of ridge further northwest, several hundred feet higher than Station 3). These shells are conspicuously larger than at Stations 2 and 3. Part of the shells are typical in sculpture, but in most of them the ribs are much *more numerous, closer, smooth,* and more regularly spaced. These close-ribbed shells agree with those from Station 5 and from Station 12, a peak on the opposite (east) side of the rim of the amphitheatre of Tweed Canyon. Probably the close-ribbed type of shell extends around the whole rim from Station 4 to Station 12.

Two out of fifteen opened have 3 lamellæ (both having many ribs), and three have only the columellar lamella (ribs few). The rest, including both many- and few-ribbed shells, have 2 lamellæ. This lot was picked up in several places along the summit of the narrow ridge, perhaps in an area of 20 x 100 yards. It therefore may comprise several colonies, and we cannot now tell whether fine- and coarse-ribbed shells occur actually together or not. There may be 12–15 ribbed colonies and 20–30 ribbed colonies, or possibly both sorts may live together. The measurements give extremes of size and are from "selected" shells.

Length	12.5,	diam.	4.1	mm.;	whorls	12¾;	lamellæ	3;	ribs	21.
"	12.3,	"	4	"	"	12½;	"	2;	"	24.
"	12.3,	"	4	"	"	12¾;	"	1;	"	15.
"	12,	"	3.9	"	"	12½;	"	2;	"	14.
"	11.8,	"	4	"	"	11½;	"	1;	"	22.
"	11.8,	"	4	"	"	12;	"	2;	"	25.
"	11,	"	3.8	"	"	12;	"	2;	"	13.
"	11,	"	4	"	"	11¼;	"	2;	"	24.
"	10.7,	"	4	"	"	11½;	"	2;	"	30.
"	10.2,	"	3.5	"	"	11½;	"	1;	"	12.
"	9.5,	"	3.5	"	"	11;	"	2;	"	15.

Station 5 (north of summit of peak north of Station 4). Shells are like the fine-ribbed ones from Station 4. No really coarse-ribbed forms were taken. Extreme and average shells measure as follows:

Length 12.3, diam. 4 mm.; whorls $12\frac{3}{4}$; lamellæ 1; ribs 27.
" 11.5, " 3.7 " " $11\frac{1}{3}$; " 2; " 16.
" 11.3, " 3.9 " " $12\frac{1}{2}$; " 1; " 29.
" 11.2, " 4 " " 12; " 2; " 38.
" 10.8, " 4.2 " " $11\frac{1}{3}$; " 2; " 16.
" 10, " 3.9 " " $11\frac{1}{2}$; " 1; " 21.

Station 18 (Pl. XIV, figs. 3, 3*a*). In the third ravine west of the granitic spur on north side of Tweed Canyon, above a dyke of igneous rock about 50 yards wide. Below this dyke, at Station 17, *Holospira campestris cochisei* is found. A deep gulley or "wash" extends from the ravine upon the mesa. The shells at Station 18 are a little more finely ribbed than typical *H. danielsi* and to that extent approach *H. campestris cochisei*. Out of 16 opened, 9 shells have 3, and 7 shells have two internal lamellæ. Measurements follow.

Length 11.3, diam. 4 mm.; whorls $12\frac{1}{3}$; lamellæ 2; ribs 22.
" 11.3, " 3.7 " " 12; " 3; " 28.
" 11, " 4 " " 11; " 2; " 13.
" 11, " 3.9 " " $12\frac{1}{2}$; " 2; " 16.
" 10, " 3.5 " " 11; " 2; " 22.
" 10, " 3.3 " " $11\frac{1}{2}$; " 3; " 26.
" 10, " 3.3 " " $11\frac{3}{4}$; " 3; " 18.
" 9.7, " 3.5 " " 11; " 3; " 22.
" 9.5, " 3.3 " " 11; " 3; " 21.
" 9.5, " 3.2 " " 11; " 2; " 28.
" 9, " 3.3 " " $10\frac{1}{2}$; " 3; " 24.

Station 20 (mouth of the second ravine west of granitic spur, Tweed Canyon). Shells similar to the preceding lot.

Station 22 (bed of the same ravine several hundred yards above the mouth). Shells similar, but averaging larger, though some are equally small; lamellæ one or two.

Length 12.5, diam. 4 mm.; whorls $12\frac{3}{4}$; ribs 16.
" 10.7, " 3.9 " " $11\frac{1}{2}$; " 20.
" 10, " 3.5 " " $11\frac{1}{2}$; " 22.

Specimens from the southeastern part of the upper amphitheatre of Tweed Canyon have *only one or two lamellæ* (parietal and axial), those with one slightly predominating. The parietal lamella is moderate or small when developed. They are also perceptibly stouter in figure than the types, and the number of ribs is, in the main, greater.

Station 10 (floor of the upper amphitheatre of Tweed Canyon, southeastern branch). Not a favorable station for Holospira, being shaded by a dense growth of shrubs and trees. A few specimens taken have one or two lamellæ, and the aperture is built forward further than in the types. Ribs as in the following.

Station 15 (further east on the same branch, a little higher). Rather stout shells, with the mouth built out shortly (nearly 1 mm.); about 15 ribs; lamellæ one or two. 12 x 4 mm.

Station 13 (eastern peak of the rim of Tweed Canyon). Fine-ribbed, like Pl. XIV, figs. 5, 5*a*.

Station 11 (steep, stony, arid, southern slope of ridge projecting into amphitheatre, vegetation xerophytic). The shells are greater in diameter than the types, very uniform in sculpture, having 16 or 17 ribs on the penultimate whorl, the peristome built forward further than usual in the type lot. 10.5 x 3.7 mm. axial or axial and superior lamellæ.

Another lot, taken a couple of hundred feet higher, are similar in form, sculpture and lamellæ; ribs 15 to 19.

Station 12 (peak on eastern rim of amphitheatre). The shells are larger than at the preceding stations, with *more ribs*, 26 to 28 on the penultimate whorl. Half of those opened have one, half two lamellæ, the superior lamella not very strong. These shells are like those from Station 4 and 5. See Pl. XIV, figs. 4 to 4*b*.

Length 13.7, diam. 4.2 mm.; whorls 13.
" 12, " 4 " " $11\frac{3}{4}$.

Station 40 (between crest and foothills, north end of the range). Stout, rather large shells, with a strongly developed columellar lamella only in several opened. 37 to 43 ribs, nearly or quite as wide as their intervals. (Pl. XIV, figs. 5, 5*a*).

Length 12.3, diam. 4 mm.
" 10.5, " 4.1 "

These shells have more ribs than any other colony of *H. danielsi*, and they may be referable to *H. campestris cochisei*. The shells are, however, larger than the latter, some of the ribs are broken down, as in *danielsi*, and the locality is distant from other known colonies of *H. c. cochisei*. Only a very small lot was taken, and, pending further collections, its identity may be left undecided.

Station 39 (between crest and foothills at north end of the range). Much larger than the typical form, stouter, with few, strong and widely separated ribs. Only the axial lamella developed. (Pl. XIV, figs. 2 to 2*c*).

Length 13.3, diam. 4.8 mm.; whorls 13; ribs 15.
" 13.5, " 4.5 " " 12; " 15.
" 14.5, " 4.1 " " $13\frac{3}{4}$ " 19.
" 11, " 4.1 " " $11\frac{1}{2}$; " 13.
" 12.1, " 4.1 " " 12; " 12.

Station 42 (further north than Station 39). Similar to the above, having the same rude sculpture, but a little smaller in the average, length 11 to 13 mm.

Station 41. Shells like Pl. XIV, figs. 4–4*b*.

Holospira campestris n. sp. Pl. XV, figs. 1, 2.

The shell is shortly rimate, cylindric, with very short terminal cone and mamillar apex. $2\frac{1}{2}$ embryonic whorls smooth (the last half whorl very narrow), following whorls closely and finely striate, the striæ of the conical portion narrower, hence appearing more widely spaced than those of the cylindric portion, on which they are as wide as the intervals. On the penultimate whorl there are about 70 striæ. The last whorl is decidedly compressed below the periphery, tapering downwards, somewhat more coarsely sculptured on the latter part. It is shortly rimate and built forward shortly from the preceding whorl. All of the whorls are very strongly convex. The aperture is angular at the upper outer part, elsewhere rounded. Peristome narrowly expanded. Axis cylindric, in the latter part of the penultimate and first part of the last bearing a stout axial lamella. There is also a long and strong parietal or superior lamella, and sometimes a basal lamella. Length 11.5, diam. 3.7 mm.; whorls 12.

Mesa at western foot of the Dragoon Mountains at Station 26, along a "wash" or gulley at the south fence of the Fourr ranch, No. 112,214, A. N. S. P. Also Stations 24, 25, in the same vicinity, etc.

Other specimens of the type lot (Pl. XV, figs. 1 to 1*d*) measure as follows. All but one of the specimens opened have two lamellæ, one having three.

Length	12,	diam.	3.9	mm.;	whorls	12.
"	11.8,	"	3.9	"	"	$12\frac{1}{2}$.
"	11,	"	3.8	"	"	12.
"	10.6,	"	4	"	"	12.
"	10,	"	3.6	"	"	$11\frac{1}{2}$.
"	9.3,	"	3.6	"	"	$10\frac{1}{2}$.
"	7.8,	"	3.3	"	"	$9\frac{1}{3}$ (a dwarf).

At Station 24, a gulley running out of the Fourr ranch, the shells are 9 to 10 mm. long, otherwise similar.

At Station 25, foothills west of the Fourr ranch (Pl. XV, fig. 2) the shells are smaller, with sculpture like the type. The peristome *adheres* for a short distance to the preceding whorl, or is *very shortly* free. The columellar lamella is within the front of the last whorl;

parietal lamella when present is very small, and most specimens lack it. They are very uniform in size and sculpture, in a long series taken.

Length	8.7,	diam.	3.2	mm.;	whorls	10;	lamellæ	1.
"	8.5,	"	3	"	"	$10\frac{1}{2}$;	"	2.
"	8.1,	"	3	"	"	$10\frac{1}{3}$;	"	2.
"	7.9,	"	3.2	"	"	$9\frac{1}{2}$;	"	1.
"	7.9,	"	3	"	"	$9\frac{3}{4}$;	"	1.
"	7.5,	"	3.1	"	"	$9\frac{1}{3}$;	"	1.
"	7.5,	"	3.1	"	"	$9\frac{1}{2}$;	"	1.
"	7,	"	3.1	"	"	9;	"	

Holospira campestris cochisei n. subsp. Pl. XIV, figs. 6 to 8*b*.

Similar to *campestris*, but more slender, with fewer ribs (28 to 40 on the penultimate whorl, in the type lot), the intervals wider. Internal lamellæ *three*, the parietal *very long and strong*.

Length	10.5,	diam.	3.3	mm.;	whorls	12;	lamellæ	3.
"	10,	"	3.1	"	"	$11\frac{1}{2}$;	"	3.
"	9.8,	"	3.1	"	"	$11\frac{1}{2}$;	"	3.
"	9.7,	"	3.1	"	"	11;	"	3.
"	9.6,	"	3.1	"	"	11;	"	3.
"	9.3,	"	3.1	"	"	11;	"	3.
"	8,	"	3.1	"	"	10;	"	3.

Dragoon Mountains: along the sides of an arroyo or gulley on the mesa within the wide mouth of Tweed Canyon, Station 16; Types No. 112,219, A. N. S. P. Also Stations 17, 19–23, and 27, all in Tweed Canyon.

The type locality, Station 16 (Pl. XIV, figs. 7–7*f*), is on the sloping sides of the arroyo, which is about 15 feet deep, and meanders across the mesa. Near the mountain the gully deepens to 30–40 feet, the sides become subvertical, and *Holospira* disappears. The mesa is grassy with some bunches of bear grass. There are some small oaks, juniper, catclaw, etc., in the arroyo. The shells are found under dead sotol and sometimes stones, etc. They reappear just below the igneous dyke near the base of the mountain, Station 17, but do not cross the dyke. Several other arroyos in the same plain were not examined, and there are doubtless many *Holospira* colonies in the neighborhood.

Station 19, on the slope near foot of mountain, below the igneous dyke. The shells resemble types of *H. c. cochisei* except that they are more finely, closely ribbed, ribs 45 to 50 on the penultimate whorl. Ten specimens opened are trilamellate.

Station 20. Mouth of second ravine west from granitic spur.

Station 21, hillside, eastern slope of second ravine from granitic spur, up to about 600 feet above bed of ravine. The shells are variable, as would be expected in a lot gathered over a considerable area, having 35 to 50 ribs on the penultimate whorl. Out of 11 opened, one has 3 lamellæ, ten have two, superior and axial. (Pl. XIV, fig. 6.)

Station 22, in the bed of the same ravine. Shells having about 56 ribs on penultimate whorl. Eight opened have 3 very strong lamellæ.

Station 23. Between Stations 21 and 2, near top. Like the preceding, lamellæ 2 or 3.

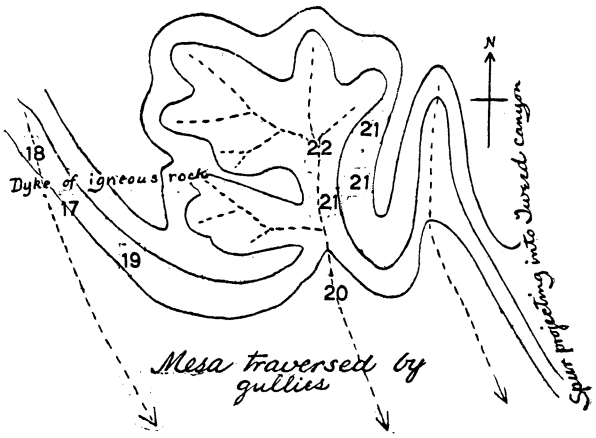

Fig. 2.—Sketch to show positions of collecting stations west of the spur in Tweed Canyon. Contour interval about 400 ft. The granitic dyke about 50 yards wide between Stations 17 and 18 separates colonies of *H. c. cochisei* (below) from those of *H. danielsi* (above).

Station 27. Rather large, length 11 mm. with 12 whorls and 36 ribs on the penultimate whorl to 13 mm. long, with 13½ whorls and 28 ribs. (Pl. XIV, figs. 8 to 8*b*.) This station is in a gulch on the south side of Tweed Canyon, the nearest approach to the area of *H. millestriata*. It shows no approach to that species in sculpture, which is coarser than in most *cochisei*. Some of the ribs were hollow and are broken down, as in *H. danielsi*. This condition is also seen to a less degree in some specimens of *cochisei* from the type locality.

Holospira millestriata n. sp. Pl. XV, figs. 3 to 5*c*.

The shell is shortly rimate, tilleul-buff, composed of about 11½ convex whorls, of which the last 5 form the cylindrical, those preceding the conical portion. Embryonic 2 whorls smooth, somewhat nipple-like, the second whorl becoming very narrow. Succeeding

whorls of the cone somewhat more sharply striate than the cylindric portion, upon which the striæ are very fine and close; typically about 90 fine, close striæ on the penultimate whorl. The latter part of the last whorl is slightly compressed and has slightly coarser, sharper striæ. The aperture is carried very shortly free, is not calloused within, and has a narrowly reflexed lip. Within the latter part of the penultimate and first part of the last whorl there is a rather stout, obtuse lamella on the axis. No lamellæ on the upper or basal walls of the cavity.

Length 12, diam. 4 mm.; 12 whorls.

Dragoon Mountains, south of Tweed Canyon, the types from Station 7, the summit of a limestone ridge separating the head of Cataract Gulch from the next canyon opening westward, south of Tweed Canyon, No. 112,225, A. N. S. P., collected by Ferriss, Pilsbry and Daniels, October, 1910. Also taken at Station 7, and Stations 29 to 37 southward from Stations 7 and 8.

H. millestriata is related to *H. campestris*, from which it differs by having more numerous, finer striæ, and by the absence of internal lamellæ on the parietal and basal walls of the cavity, in a long series of shells opened. Its range is separated from that of *H. campestris* by the ridge of eruptive rock which runs from Cochise stronghold along the south side of Tweed Canyon westward to the mesa; no Holospiras being found on this ridge, so far as we know. The isolation of the two species seems, therefore, to be complete. The species is quite constant in hundreds of shells collected from many colonies, as noted below; but in two stations in small hills on the mesa eastward of Middlemarch Canyon there is notable variation. Further study should be given to these small forms of the border between mountain and plain. In over a hundred shells opened from all the colonies, only one has a very weak trace of a superior lamella, all others having only a stout axial lamella.

The type locality, Station 7, is on the divide, a ridge above an abandoned mine and cabin. It may be reached by ascending Cataract Gulch from Tweed Canyon, but much more easily along the mountains eastward, as the gulch is rather a neckbreaker. The specimens are quite uniform in sculpture. Length up to 12.2 mm., and very rarely as short as 9.3 mm., with 10 whorls. (Pl. XV, figs. 3, 3*a*, 3*b*). Out of twenty opened, one has a weak, hardly perceptible trace of the superior lamella, the others having the axial lamella only. A series of 1000 or more was taken. It occurs under stones, etc., in places where there is no shade.

At the adjacent Station 8, eastward and slightly higher, the shells average smaller—about 10.5 mm. long—but are otherwise similar.

Station 29. Bear Gulch, near top, and Station 30, ridge west of Bear Gulch, typical shells.

Stations 31, 32, on the east side, and Station 33 on the west side of Soren Gulch, typical shells.

Station 34. A small limestone hill in Middlemarch Canyon. The shells have perceptibly coarser sculptures than in the types, about 70 riblets on the penultimate whorl. One internal lamella, the axial.

Station 35. Cochise Peak. Similar to the shells from Station 34.

Station 36. Small limestone hills eastward on the mesa of Middlemarch Canyon. The shells here are smaller than typical *millestriata,* and vary from the typical fine ribbing to somewhat coarser (Pl. XV, figs. 4, 4*a*, the prevalent form), and a few are as coarsely sculptured as *H. campestris cochisei,* the coarsest having 48 ribs on the penultimate whorl. The proportions of diameter to length also vary a good deal, as shown in the figures and measurements. All the specimens opened have a single lamella, the axial.

Length 9.5, diam. 3.6 mm.; whorls 11.
" 9.1, " 3.3 " " $10\frac{3}{4}$.
" 9.6, " 3.1 " " 11.
" 9.2, " 3.5 " " $10\frac{1}{2}$.
" 8, " 3.2 " " 10.

Station 37. Another colony near the preceding, consists of very small shells. (Pl. XV, figs. 5 to 5*c*.)

Length 9, diam. 3.2 mm.; whorls $10\frac{1}{2}$.
" 7.2, " 3.2 " " $9\frac{1}{2}$.

It is evident that *H. millestriata,* which is very constant in the mountains, varies in size, proportions and sculpture in the different ecologic conditions of the lower, more arid mesa.

ZONITIDÆ.

Vitrea indentata umbilicata Ckll.

Dragoon Mountains: Stations 1, 2, 3, 6, $6\frac{1}{2}$, 7, 10, 11, 15, 18, 25, 26, 28, 29, 35; therefore generally distributed, probably wherever snails live, as some of the stations were only hastily examined for the larger shells.

Zonitoides arborea (Say).

Dragoon Mountains: Station 28.

Zonitoides minuscula alachuana (Dall).

Dragoon Mountains: Stations 1, 6½, 10, 15, 26, 28, 29.

Striatura milium meridionalis P. and F.

Dragoon Mountains: Stations 1, 6, 10, 29.

Euconulus fulvus (Müll.).

Dragoon Mountains: Stations 1, 10, 15, 28 and *E. f. alaskensis*, Station 29.

ENDODONTIDÆ.

Pyramidula cronkhitei (Newc.).

Dragoon Mountains: Stations 28, 29.

Radiodiscus millecostatus Pils. and Ferr.

Dragoon Mountains: Stations 1 and 10; rare.

Helicodiscus arizonensis Pils. and Ferr.

Dragoon Mountains: Stations 1, 6½, 10, 28, 29.

Punctum californicum Pils.

Dragoon Mountains: Station 10, in the amphitheatre or upper basin of Tweed Canyon. The specimens are a little more openly umbilicate than the type, but the riblets are more unequal than in *P. pygmæum*, and spiral lines are scarcely discernible.

SUCCINEIDÆ.

Succinea avara Say.

Dragoon Mountains: Stations 2, 3; single dead specimens.

FERUSSACIDÆ.

Cochlicopa lubrica (Müll.).

Dragoon Mountains: Stations 1, 6, 6½, 10, 15, 28, 29. Abundant.

PUPILLIDÆ.

Bifidaria ashmuni Sterki.

Dragoon Mountains: Stations 1, 3, 6, 10, 11, 15, 25, 26, 29.

Bifidaria perversa Sterki.

Dragoon Mountains: Stations 2, 3, 22.

Bifidaria dalliana Sterki.

Dragoon Mountains: Stations 3, 6, 26.

Bifidaria pilsbryana Sterki.

Dragoon Mountains: Stations 1, 2, 10, 11, 15, 18, 25, 28, 29.

Vertigo coloradensis arizonensis P. and V.

Dragoon Mountains: Station 25.

VALLONIIDÆ.

Vallonia perspectiva Sterki.

Dragoon Mountains: Stations 1, 6, 10, 15, 25, 26, 28, 29. In copious numbers.

II. The Mule Mountains.

This group is between the southwestern outliers of the Chiricahua Range and the Huachucas, and is much lower than either, the highest summits about 7,000 feet. The greater part of the group is igneous rock, but the Escabrosa Ridge, running along the western and southern borders, is limestone. Collecting was done in the vicinity of Bisbee and Warren, August 29 and 30, 1910, by Daniels and Pilsbry. We found nothing in the igneous area, but *Sonorella* probably lives on the higher peaks.

The Geological Survey has published a topographic sheet of this region.

Sonorella bartschi n. sp. Pl. VIII, figs. 4, 4*a*, 4*b*.

The shell is strongly depressed, rather openly umbilicate (width of umbilicus contained nearly six times in the diameter of shell), moderately strong, though thin; color between cinnamon and wood brown, fading to white around the umbilicus, and encircled above the periphery with a dark chestnut band, bordered above and below with white bands, as wide as the dark band or wider. Surface glossy; initial $\frac{1}{3}$ whorl of the embryonic shell smooth; a few radial wrinkles follow, after which it has radial striæ which become more or less interrupted, forming irregular, long granules; beginning with the second whorl, there are short hairs, subregularly placed in forwardly descending rows; these continue to the penultimate whorl, where they weaken and disappear. The last whorl has a weak sculpture of growth wrinkles only.

Whorls about $4\frac{1}{2}$, rather slowly increasing, convex, the last descending well below the periphery in front. Aperture strongly oblique, subcircular. Peristome thin, expanded rather slightly above, strongly below, the ends approaching and joined by a very short but distinct parietal callus.

Alt. 11.2, diam. 20 mm.; aperture 9.7 x 10.5 mm.; umbilicus 3.5 mm. wide; whorls $4\frac{3}{4}$.

Alt. 10.2, diam. 18 mm.; aperture 8 x 9 mm.; umbilicus 3.3 mm. wide; whorls $4\frac{1}{2}$.

The back and tentacles are slate colored, sides gray. The sole shows no longitudinal divisions or areas.

The penis is long, its lower half very slender, enveloped in a long sheath composed of glossy circular muscular tissue. The upper half is somewhat swollen. The penis-papilla (fig. 1*a*) is rather short, cylindric, very faintly wrinkled transversely, the distal end obtuse, rounded. The flagellum is about 0.8 mm. long. The vagina is about half as long as the penis. Other ♀ organs as usual in the genus (Pl. XI, fig. 1, from Station 1, near Bisbee, No. 103,095). Length of penis 14 mm.; epiphallus 11 mm.; penis-papilla about 5 mm.; vagina 7 mm.; spermatheca and duct 22 mm.

Mule Mountains: Mt. Ballard, in the Escabrosa Ridge; about 2 miles west of Bisbee, Arizona, on a ledge of the north side near the summit. Type No. 103,095, A. N. S. P., collected by Pilsbry, August 31, 1910. It was also taken on the northern slope of a limestone hill about two miles east of Warren, Arizona.

Other specimens from the type locality measure as follows:

Alt. 10.8, diam. 20 mm.; umbilicus 3.3 mm.; whorls $4\frac{2}{3}$.
" 10, " 18.8 " whorls $4\frac{2}{3}$.
" 9.8, " 18 "
" 8.8, " 17.5 "
" 8, " 16.4 "
" 7.2, " 14.5 " umbilicus 2.9 mm.; whorls $4\frac{1}{2}$.
" 7, " 14 " " 3 " " $4\frac{1}{4}$.

The shell is quite characteristic by its conspicuous white bands bordering the dark band at the shoulder, the rather open umbilicus, and the nearly circular, strongly oblique aperture. It is a handsome snail when fresh, not closely resembling any other species we have seen. Its nearest neighbor is *S. mearnsi* Bartsch, from San José Mountain, which lies just south of the international boundary near Naco, a railroad station on the El Paso and Southwestern R. R. *S. mearnsi* has a narrower umbilicus, less conspicuous white bands, only 4 whorls, the periphery of the last somewhat subangular, and the surface is very minutely granular.

The hairs of the neanic whorls are very delicate and fugacious; but when they are gone the spire still remains rougher than the last whorl, having an indistinct pattern of radial wrinkles or irregular, long granules. This disappears entirely on the last whorl. The embryonic whorl (beyond the initial half-whorl, which is alike in nearly all Sonorellas) is not marked with the protractive raised lines or series of granules of *S. hachitana* and its numerous group.

By its genitalia *S. bartschi* resembles the Chiricahuan *S. bowiensis*, but that differs by having close, finely developed sculpture of threads

forming tangents and V-shaped figures on the last embryonic whorl, as well as in various features of the adult shell.

We do not find in the shells of the Warren form any constant difference from those of the type locality; but the genitalia (Pl. XI, fig. 2) and jaw (Pl. XI, fig. 2*b*) differ somewhat in the only living adult taken. The penis has scarcely any sheath; only a few fibres bind the epiphallus. Flagellum more minute. Penis-papilla (fig. 2*a*) nearly half the length of the penis, tapering and wrinkled. The penial retractor is inserted on the epiphallus near its base. The vagina is nearly as long as the penis. Length of penis $10\frac{1}{2}$ mm.; epiphallus 10 mm.; penis-papilla 5 mm.; vagina 9 mm.

The jaw (Pl. XI, fig. 2*b*) has about 5 weakly developed ribs.

Thysanophora hornii (Gabb).

Limestone hill 2 miles east of Warren.

Holospira arizonensis mularis n. subsp. Pl. XV, figs. 8 to 8*e*.

The shell is very shortly rimate, cylindric, with short terminal cone, wood brown or avellaneous, the last half of the last whorl opaque white; composed of $10\frac{1}{2}$ to $13\frac{1}{2}$ whorls, the first two smooth. The last half of the second and first half of the third whorl are narrower than the preceding and following whorls, as usual, and the apex projects somewhat nipple-like. Following whorls of the cone are quite convex, and are sharply, closely and obliquely striate. On the cylindrical portion the whorls are only weakly convex, and gradually lose the striæ, so that the penultimate and often one or two earlier whorls are smooth or nearly so, the last half-whorl becoming strongly, sharply striate again. The last whorl is compressed laterally on the back but becomes rounded near the aperture, preceding which it is somewhat contracted. The aperture is rotund-ovate, peristome shortly free of the preceding whorl, and quite narrowly expanded. Internal axis rather small, in the last part of the penultimate and the beginning of the last whorl becoming a moderate, obtuse lamella. Typically there are no other lamellæ, but in a small number of specimens a superior lamella, or superior and basal lamellæ are developed, both very weak.

Length	13.1,	diam.	4.2	mm.;	whorls	12.
"	13.6,	"	3.9	"	"	$13\frac{1}{2}$.
"	13.8,	"	4	"	"	13.
"	12.2,	"	4.2	"	"	$11\frac{1}{2}$.
"	10.2,	"	4	"	"	11.
"	9.3,	"	3.9	"	"	$10\frac{1}{2}$.

Mule Mountains, on the northern slope of the Escabrosa Ridge, west of Bisbee, Arizona, at about 6,000 to 6,500 feet elevation.

Type No. 112,236, A. N. S. P., collected by Pilsbry and Daniels, August 29, 1910.

The Escabrosa Ridge, or mountain side on the left, ascending the first left-hand ravine above Bisbee on the Tombstone Road, is the home of this *Holospira*. Extensive burning of the brush has narrowed their range and decreased their numbers, at least for the time, so that the series collected was not large.[3] Some very small scrub oaks remain in places; there are three species of agave, some sotol and bear-grass, a few cylindropuntias, and many herbaceous plants, now after the summer rains gay with flowers; over everything a little scarlet morning-glory, which we afterward found common in the ranges westward.

Out of 20 shells opened, 18 have the axial lamella only; one has also a small superior or parietal, and one has superior and basal lamellæ, both very low and small.

This is a larger and longer species than *H. ferrissi*, and further distinguished by the smooth later whorls and deficient internal lamellæ. The Chiricahuan *H. arizonensis* Stearns differs chiefly by having the internal lamellæ larger.

Holospira ferrissi fossor n. subsp. Pl. XV, figs. 6 to 6*b*.

The short, cylindric shell is ribbed throughout, with about 47 ribs on the penultimate whorl. The last whorl is conspicuously flattened on the back, then gibbous (the gibbosity internally filled with white shelly material) and contracting to the aperture, the basal crest rather conspicuous. These features are more conspicuous than in *H. ferrissi*. There is an obtuse axial lamella in the front of the last whorl, and typically no other lamellæ; but three specimens out of 20 opened show a weak parietal lamella also. The color is wood brown or avellaneous, with the usual white patch on the last whorl.

Length	8.7,	diam.	3.3	mm.;	$10\frac{1}{3}$	whorls (type).
"	6.4,	"	3.3	"	$8\frac{1}{3}$	" (shortest shell).
"	9.8,	"	3.6	"	$10\frac{1}{2}$	" (largest shell).
"	9.3,	"	3.3	"	$10\frac{3}{4}$	" (slender shell).

Mule Mountains: on slopes of a limestone peak about 2 miles east of Warren, Arizona. Type No. 112,238, A. N. S. P., collected by Pilsbry and Daniels, August 31, 1910.

The town of Warren may be reached by a trolley line from Bisbee. It lies lower than Bisbee and is separated from the plain by a range

[3] 180 specimens in the lot taken by Pilsbry, probably as many or more taken by Daniels; most of them dead shells.

of hills which reach about 5,500 feet elevation. On the northern and northwestern slopes of one of these, about two miles east of the town, we collected *Sonorella, Holospira* and some smaller shells. *Holospira* is very abundant (over 1,500 collected by H. A. P.), living in mellow earth under stones, in "nests" of from six to twenty or more, usually standing vertically, apex up, and buried in earth up to the summit. While the sculpture of this species is coarser than that of typical *H. cionella,* yet there are some equally coarse individuals of the latter. It is quite possible that *H. cionella* may eventually be ranked as a subspecies of *H ferrissi.*

In the débris of the San Pedro River above the S. P. R. R. bridge, near Benson, Arizona, we found three specimens representing as many races of *Holospira.* One is the upper half of a slowly tapering species, evidently new. The others are probably races of *H. ferrissi.* One specimen has the appearance of a small *H. f. fossor.* It has the same sculpture, a low axial lamella, and measures, length 7.6, diam. 3.1 mm., $9\frac{3}{4}$ whorls.

The other shell resembles *H. ferrissi* in having three internal lamellæ, the superior and axial lamellæ being strongly developed. The ribbing is as fine as in the most finely ribbed *ferrissi*—decidedly finer than in *fossor.* The form is more slender than in *ferrissi.* This shell apparently represents another subspecies or local race of *H. ferrissi.* As it may have drifted a long distance, it had better be left nameless until found in its natural habitat.

Holospira ferrissi sanctæcrucis n. subsp. Pl. XV, fig. 7.

The shell is similar to the most slender and fine-ribbed examples of *H. ferrissi* in form and sculpture, except that the apical whorls are more mucronate. The three internal lamellæ are lateral in position, strongly developed, especially the superior one, which is a half-whorl long.

Length 8.5, diam. 3.2 mm.; whorls $11\frac{3}{4}$.

Valley of the Santa Cruz River, above Tucson, Arizona. Type No. 112,239, A. N. S. P., found in flood débris of the river a short distance above the Congress St. bridge, Tucson.

This is some distance west of any other record of *Holospira* in the United States. In Mexico the genus extends to the Gulf of California. The lamellæ are much stronger than in any of the lot of *H. ferrissi* which we have opened.

Although there cannot be much doubt that this species inhabits some limestone hill not far from the river, we failed to find it in the quite limited time we spent in the neighborhood. It may have

floated many miles, as the river merits that name in time of flood, though usually reduced to a chain of infrequent pools or an insignificant rivulet. The term river, in the arid belt, refers to the bed and banks rather than to the water, which is often conspicuous for its absence during a great part of the year.

ZONITIDÆ.

Vitrea indentata umbilicata (Ckll.).

Two miles west of Bisbee, and about the same distance east of Warren, on limestone hills, with *Holospira*.

PUPILLIDÆ.

Bifidaria pellucida hordeacella (Pils.).

Limestone hill about 2 miles east of Warren, Arizona.

III. BENSON, ARIZONA.

Benson, Cochise Co., at the junction of the Southern Pacific and El Paso and Southwestern Railroads, is in a flat region, with no mollusk fauna in its immediate environs. The San Pedro River, flowing northward about a mile east of the town, brings down considerable flood débris containing shells. The source of these is probably in the foothills of the Whetstone Mountains, not far away; possibly also the hill country about Tombstone, or even further south.

The San Pedro carries more water than any other stream in the lower tier of counties between the Rio Grande and the Colorado, and so far as we know it is the only one maintaining a constant flow. At Benson it is a turbid stream 20 to 30 feet wide, with vertical, dirt banks about 8 feet high (September 1st), meandering in a flood plain covered with mesquite.

Mr. Ferriss collected a few shells from the river drift in 1904; and in 1910 Pilsbry and Daniels, having an hour or two between trains, collected a small bag of shell-bearing débris near the S. P. R. R. bridge. In this sample the most abundant mollusk is *Bifidaria procera cristata*. The small *Zonitoides*, *Bifidaria p. hordeacella*, *Pupoides marginata* and *Vertigo ovata* are next in abundance. All the species except *Vallonia gracilicosta* are Lower Sonoran forms.

THYSANOPHORA HORNII (Gabb).
HOLOSPIRA FERRISSI Pils. (variety). See p. 388.
" F. FOSSOR P. and F. See p. 387.
" n. sp. (spire only).
VITREA INDENTATA UMBILICATA (Ckll.).
ZONITOIDES MINUSCULA ALACHUANA (Dall).
" SINGLEYANA (Pils).

SUCCINEA AVARA Say.
VALLONIA GRACILICOSTA Reinh.
" PERSPECTIVA Sterki.
PUPILLA BLANDI Morse (3).
" HEBES (Anc.) (1).
" SYNGENES (Pils.) ($\frac{1}{2}$).
PUPOIDES MARGINATA (Say).
" HORDACEA (Gabb).
BIFIDARIA PROCERA CRISTATA (P. and V.).
" PELLUCIDA HORDEACELLA (Pils.).
" ASHMUNI Sterki. (1).
" PERVERSA Sterki.
" PENTODON (Say).
" TAPPANIANA (C. B. Ad.).
" TUBA P. and F.
VERTIGO OVATA (Say).
" MILIUM Gld. (1).
LYMNÆA PARVA Lea.
" BULIMOIDES COCKERELLI P. and F.
PLANORBIS CARIBÆUS Orb.
" LIEBMANNI Dkr.
" PARVUS Say.
" ARIZONENSIS Pils. and Ferr.[4]
PHYSA VIRGATA Gld.
AMNICOLA sp. (two dead specimens).
SPHÆRIUM TRIANGULARE (Say).
PISIDIUM COMPRESSUM Prime.

Vertigo milium, Bif. tappaniana and *Sphœrium triangulare* (one valve) were obtained in 1904, not in 1910. The latter is new to the fauna of the United States, but having compared with the type specimens, we are satisfied of its identity.

Part of the specimens we refer to *Lymnœa parva* agree with cotypes of *L. dalli;* but we have been unable to make a satisfactory division of the material.

Columella edentula (Drap.) in the Huachucas.—We may add here a species accidentally omitted from the Huachuca list published in part III, of this series (1910). It was found at Wickersham's, Miller Peak.

IV. THE SANTA RITA MOUNTAINS.

This fine and well-wooded range forms the eastern boundary of the Santa Cruz River Valley. We drove in from Siding No. 4 on the Sonora Railroad, camping at Agua Caliente, a large tepid spring flowing into an artificial pool at the mouth of the canyon of the same name, the elevation about 3,800 feet. Several *Sonorella*

[4] *Planorbis arizonensis*, new name for *P. filocinctus* Pilsbry and Ferriss, Proc. A. N. S. Phila., 1906, p. 165, not of Sandberger.

colonies were found near by. Our second camp was at the cabin in the saddle at the head of Agua Caliente Canyon, somewhat above 7,000 feet and close to collecting Station 6 of map. There is a good spring. The best collecting is in Walnut Canyon, Station 5, where three species of *Sonorella* live. From above this camp there is fine timber, but no land shells worth mentioning up to the summit of Mt. Hopkins. Good collecting stations were found in Madera Canyon which would be an excellent place to camp. We also reached the head of Josephine Canyon from this camp. A two-day excursion was made, via Brandt's mining camp, over the 8,500-foot saddle north of Old Baldy, and down Camperel Canyon[5] to perhaps 7,000

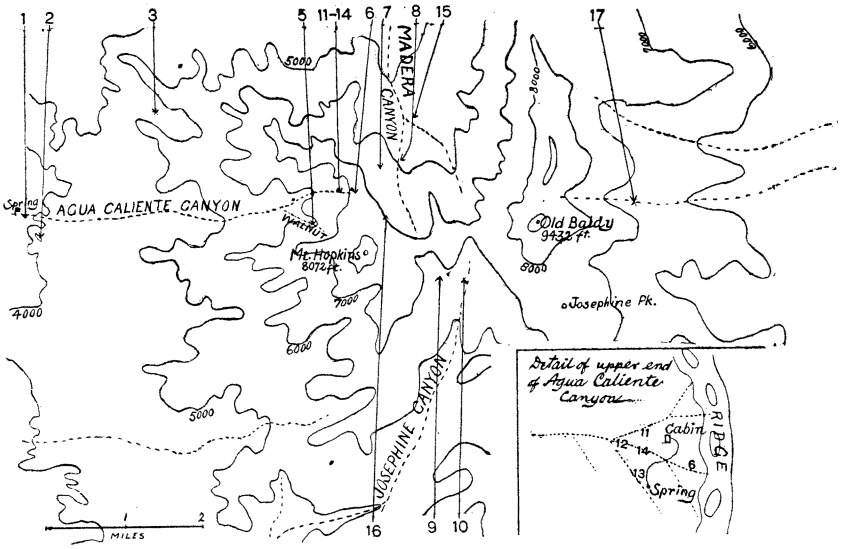

Fig. 3.—Collecting stations in the Santa Rita Mountains. Contour interval, 1000 feet.

feet. There is fine pine on the top and extending some distance down. Also some huge spruce and hemlock trees. We passed through aspens, then small-leaved maples, to walnuts, in the bed of the canyon. *Sonorella clappi* occurs here, and a few specimens of a *Sonorella* (*occidentalis*), which we provisionally rank as a subspecies of the Huachucan *S. granulatissima*. It will be seen that our work extended nearly across the middle of the highest part of the range in a rather narrow band, the collecting stations being marked on the accompanying tracing simplified from the U. S. G. S. topographic map.

[5] This canyon is not named on the topographic map. On it Stetson's dam is situated, lower down.

The absence of the common western Sonorellas (*santaritana* and *walkeri*) on the eastern slope, and the occurrence there of another species (*S. g. occidentalis*) indicates a certain amount of local faunal differentiation, and it seems likely that work in the northern, southern or eastern parts of the range would result in a number of additional species of *Sonorella*. By the absence of *Oreohelix* and *Ashmunella* (in the parts we explored), the Santa Ritas differ remarkably from the Huachucas, the next range eastward.

We obtained very few small shells.

Vitrea indentata umbilicata (Ckll.), Stations 7, 12, 17.

Euconulus fulvus (Müll.), Station 7.

The locations of collecting stations follow.

Station 1. In rock along banks of stream flowing from Agua Caliente Canyon, immediately south of the spring.

Station 2. Northern base of bluff southeast of Station 1.

Station 3. About half way up "Soldier Canyon," a short canyon immediately north of the mouth of Agua Caliente.

Station 4. Pool of Agua Caliente Spring (*Physa humerosa* (?), frogs, etc. collected).

Station 5. Walnut Canyon or branch of Agua Caliente, which opens about 200 yards below the miners' cabin midway of A. C. Canyon. Shells abundant above and below the mine, in piles of heavy granite rock. None found in "Walnut basin" higher up.

Station 6. On the ravine south of cabin in the saddle, at head of Agua Caliente.

Station 7. Madera Canyon, about half way down the steep slope from camp.

Station 8. Madera Canyon, about 100 yards above "Old Johns Camp" in an extensive rock pile in the bed of the canyon, about 10 feet above the stream. This is opposite the saddle at head of Agua Caliente.

Station 9. Head of Josephine Canyon, on the flank of Mt. Hopkins, in friable, angular, rocky banks of canyon.

Station 10. Head of Josephine Canyon, a few hundred feet up the branch leading to the saddle next to Old Baldy.

Station 11. About 100 yards west of camp in saddle.

Station 12. Half a mile down (west) from camp.

Station 13. About 10 rods above Station 12, on the branch leading to the spring near camp.

Station 14. A short distance above Station 12 on the branch running near camp.

Station 15. Bed of Madera Canyon near the fork.

Station 16. Eastern (Madera) flank of Mt. Hopkins, about a mile south of Station 7.

Stations 17, 17½. Camperel Canyon, on the eastern slope of the range.

Sonorella santaritana n. sp. Pl. IX, figs. 1 to 3.

The shell is depressed, umbilicate (the width of umbilicus contained between 6 and 7 times in diam. of shell), solid, between cinnamon-buff and pinkish-buff, becoming whitish on the base, and having a chestnut-brown shoulder band bordered with white.

The surface is rather glossy. Embryonic shell of $1\frac{1}{2}$ whorls; after a very short initial smooth stage, the surface becomes radially rippled, then densely granular, the granules lengthened in an obliquely spiral direction, becoming longer with the growth of the embryo, the last $\frac{2}{3}$ whorl of the embryo marked with threads forming V-shaped figures, their intervals densely, subregularly wrinkled radially.

The post-embryonic whorls have very fine, inconspicuous growth lines and excessively faint spiral lines on the last whorl, above and at the periphery. The spire is very low conic. Whorls $4\frac{1}{2}$, convex; the last descends deeply in front. The aperture is very oblique, small; peristome narrowly expanding, pale brown at the edge, the margins converging, so that the thin, transparent parietal callus is short. In the last whorl the umbilicus enlarges to about double its previous width.

Alt. 13, diam. 23, width of umbilicus 3.6 mm.; aperture 10.5 x 12 mm.

Santa Rita Mountains, Arizona, in Walnut Canyon (a branch of Agua Caliente Canyon) at about 6,000 feet elevation, Station 5, Ferriss, Daniels and Pilsbry, 13–IX–1910. Type No. 112,105, A. N. S. P. Also taken at Stations 11, 12, 13, 14, between 6,000 and 7,000 feet, near the head of Agua Caliente Canyon; Stations 7, 8, 16, in Madera Canyon, from about 5,700 to nearly 7,000 feet, and at Stations 9 and 10, in the head of Josephine Canyon, near the ridge connecting Mt. Hopkins and Old Baldy, at about 6,500 feet.

Genitalia (fig. 4).—The penis and vagina are extremely long. Penis is rather slender, and lies in three folds in the

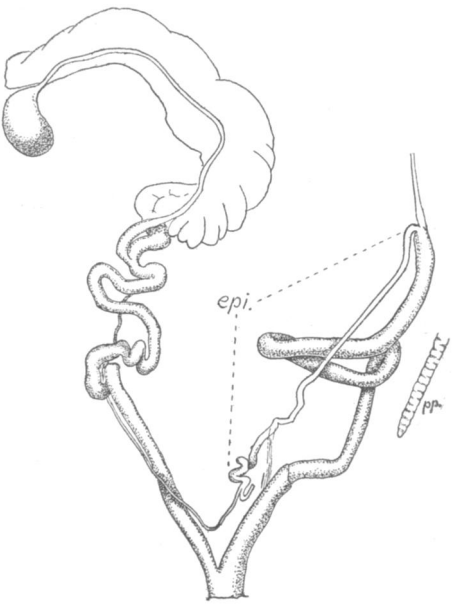

Fig. 4.—Genitalia of *S. santaritana*. *epi.*, epiphallus; *pp.*, end of the penis-papilla.

body. It has a basal sheath, and a slender, conspicuously annulated papilla, one-third the length of the penis or longer. The flagellum is well developed for *Sonorella*. The penial retractor is inserted at the apex of penis and base of epiphallus. The vas deferens is slender throughout. Measurements of the organs in mm. follow.

Station.	Penis.	Penis-papilla.	Epiphallus.	Flagellum.	Penial retractor.	Vagina.	Spermatheca and duct.	Diam. of shell.
5	33	.....	22	1.5	14	29	28	23
5	40	13	27	.....	.....	34	.....	22.3
12	27	.....	26	1.8	15	33	.....	23.5
9	31	12.5	.....	.....	18	36	.....	20
10	41	17	18+	2	15	36	27	22.5

Specimens from Station 11, and numerous others from Station 5, opened but not measured, were sufficiently examined to show that the specific characters—great length of penis and vagina—are constant.

S. santaritana differs from other species of the same range by its *wider umbilicus*, the more approaching ends of the lip, and especially by *the great length of penis and vagina*. In the characters of the genitalia it is nearest to *S. rinconensis* P. and F. (these PROCEEDINGS for 1909, Pl. XXII, fig. 5). That species differs by having a still longer vagina, and a more capacious shell with larger aperture and relatively smaller umbilicus. *S. dalli* and *S. virilis* are somewhat related, but differ in characters of both genitalia and shell.

This is the most abundant and widely distributed *Sonorella* of the part of the Santa Rita Range which we explored.

In size, specimens from Walnut Canyon (Pl. IX, figs. 1–2*b*) measured from 19 to 25.8 mm. diameter, but only in one colony were such small ones found, the minimum size in other colonies is about 21.5 mm.

In Stations 10, 11 and 14 they run from 20.4 to 22.5 mm. In other stations the size is about typical.

A beautiful albino (Pl. IX, fig. 3) was taken at Station 5. It shows very faint traces of the shoulder band and the embryonic shell is faintly buff, but otherwise it is pure white. Genitalia as in the colored form.

Sonorella walkeri n. sp. Pl. IX, figs. 4, 4*a*, 4*b*.

The shell is umbilicate (the width of umbilicus contained about 9 times in the diameter of the shell), rather solid, pale cinnamon,

fading to white around the umbilicus and on both sides of the chestnut-brown shoulder band.

The surface is glossy, lightly marked with growth lines, and under a strong lens showing impressed spiral lines on the upper surface of the last whorl (lacking, however, in many individuals). Initial $\frac{1}{3}$ whorl radially rippled, granulation then beginning, the last $\frac{2}{3}$ whorl having close protractively spiral threads, the intervals densely wrinkled radially. Spire very low conic. Whorls $4\frac{2}{3}$, the last descending in front. The aperture is rounded oval; peristome narrowly expanding, inconspicuously brown-edged, slightly thickened within, the margins converging, joined by a thin, brownish-edged parietal callus.

Alt. 14, diam. 23 mm.; umbilicus 2.6 mm.; aperture 12 x 13 mm.

Genitalia (Pl. XII, figs. 1–3, 5, 5*a*).—The penis is *small and slender*, at the base enclosed in a short but thick sheath. Penis-papilla cylindric, more than half the length of penis, tapering distally to a blunt or a somewhat pointed end. Retractor muscle inserted on the epiphallus near its base. Epiphallus as long as the penis or somewhat longer, terminating in a *minute, bud-like flagellum*. Lower part of the *vas deferens large*, its diameter equal to or exceeding that of the epiphallus. Vagina usually about twice the length of the penis.

Santa Rita Mountains, the type from Station 5, Walnut Branch of Agua Caliente Canyon, at about 6,000 feet, with *S. santaritana* and *S. clappi*, type No. 112,164, A. N. S. P., collected by Ferriss, Daniels and Pilsbry, 1910. Also taken at Station 3, "Soldier Canyon," at about 4,500 feet, and in Madera Canyon at Stations 7, 8 and 15.

This fine species, named for Dr. Bryant Walker, is not uncommon, though less generally distributed than *S. santaritana*. In the type locality it lives with *S. santaritana* and *S. clappi*, sometimes all under the same rock, sometimes in separate rock piles. The smallest specimens, Station 5, measure 20 mm. in diameter; the largest, Station 15, 24.3 mm.

Station 3 is in a small canyon running in north of the mouth of Agua Caliente, opening to the mesa between two high granite crags. The rock is a coarse granite, and shells are not numerous. A single giant cactus growing here is further east than we have seen the species elsewhere.

Many specimens have been dissected. The slender, short penis, with a short, thick basal sheath, and the enlarged free vas deferens

are conspicuous characters. The smaller umbilicus and less depressed contour separate it from *S. santaritana*, which also differs more fundamentally by its genitalia. *S. walkeri* is very much like *S. clappi* in soft anatomy. Its relation to *S. huachucana* Pils. remains to be defined when that species shall have been dissected. Measurements of the organs in mm. follow.

Station.	Penis.	Penis-papilla.	Epiphallus.	Flagellum.	Vagina.	Spermatheca and duct.
5	4.7	2.3	5	1	8	.....
5	5	3	5	Minute	7	.....
8	4	2.3	6	"	10	.....
15	4.3	2.8	7.3	"	10	.....
3	4	3	6.5	0.7	7.5	26
	7	5	6.7	Minute	7	.....

Sonorella walkeri aguacalientensis n. subsp. Pl. IX, figs. 5, 5*a*, 5*b*, 6, 6*a*, 6*b*.

A form with the shell not constantly distinguishable from *S. walkeri* was found in some abundance at Stations 1 and 2, in the mouth of Agua Caliente Canyon. Station 1 is in rocks on the bank of the wash running out of the canyon, immediately southeast of the fine spring of tepid water which gives this canyon its name. This is the lowest Station for any snail found in these mountains, the elevation being about 3,800 feet. All of the alcoholic specimens of this lot were lost after leaving the mountains, so that the anatomical characters are unknown. The shells measure 19 to 24 mm. in diameter and live in crevices or under fragments of a friable, shale-like rhyolite, of a dark vinaceous-drab color. See Pl. IX, figs. 6, 6*a*, 6*b*.

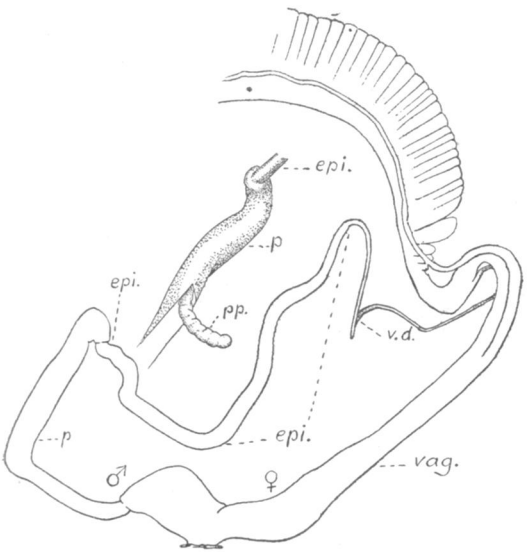

Fig. 5.—Genitalia of *S. w. aguacalientensis*, Station 2, with detail of penis-papilla (*pp.*). *epi.*, epiphallus; *p.*, penis; *vag.*, vagina; *v.d.*, vas deferens.

Station 2, at the base of bluffs southeast of Station 1 and somewhat higher, afforded a few similar shells (Pl. IX, figs. 5, 5*a*, 5*b*). One preserved in spirit differs from *S. walkeri* by having a decidedly longer penis, penis-papilla and epiphallus. There is no flagellum, and no penial retractor muscle was found. (Fig. 5.) These differences, if confirmed by further dissections, in our opinion, indicate a distinct species; but to direct attention to it we now rank the race as a subspecies of *S. walkeri*. The diameter at Station 2 runs from 22.3 to 24 mm. The elevation of this Station is between 4,100 and 4,200 feet, according to the topographic map.

Sonorella clappi n. sp. Pl. IX, figs. 8, 8*a*, 8*b*.

The shell is umbilicate (umbilicus contained about 8 times in the diameter), thin, depressed, semimatt, cinnamon, the base paler, fading to olive-buff in the middle, and with a chestnut-brown shoulder band having paler borders. Embryonic shell of $1\frac{2}{3}$ whorls, the initial $\frac{1}{4}$ whorl smooth, the rest densely and evenly reticulate-granulous, having an indistinct zigzag pattern in some places, but without the spirally descending threads of the *hachitana* type. Subsequent whorls are lightly striate and microscopically wrinkle-granose, this sculpture becoming weaker on the base. Whorls $4\frac{1}{3}$, the last descending in front, rounded peripherally. Aperture rounded-oval, the peristome thin, narrowly expanded.

Alt. 10.3, diam. 19 mm.; umbilicus 2.4 mm. (type).
" 10.3, " 18 " (globose topotype).
" 9, " 17.7 " (depressed topotype).

Genitalia (Pl. XII, figs. 6, 7).—Penis slender throughout, with a thick, short basal sheath and a long papilla. Epiphallus and vas deferens slender, the former terminating in a minute flagellum, the retractor muscle inserted close to its base. Vagina shorter than the penis. Measurements in mm. follow.

Station.	Penis.	Penis-papilla.	Epiphallus.	Flagellum.	Vagina.	Spermatheca and duct.
8	8.5	6	8.5	Minute	5	.....
12	6.5	.....	8	Minute	3	25

Santa Rita Mountains: Station 8, Madera Canyon, type No. 112,163. Also taken at Station 16, Madera Canyon; 6, 12, 13, 14 near the head of Agua Caliente Canyon; abundantly at Station 5,

Walnut branch of Agua Caliente; and Stations 17 and 17½, Camperel Canyon, on the eastern slope of the mountains, at about 6,500 feet.

This is a smaller, thinner shell than other Santa Rita Sonorellas, and readily distinguished by its microscopic granulation and the beautiful sculpture of the embryo. It is variable in degree of elevation of the spire, size of umbilicus and color. In Madera Canyon the shell has a russet hue.

In Walnut Branch of Agua Caliente the color ranges from almost chamois in the thicker old individuals to nearly water green in those barely grown to full size. The microscopic granulation is sometimes typically developed on the last whorl, but more often more or less obsolete, sometimes only visible in a few places; and most specimens show incised spiral lines on the last whorl, occasionally quite distinct and numerous. Around the head of Agua Caliente Canyon the color is similar to the Walnut Branch lot.

S. clappi resembles the Huachucan *S. granulatissima* and *S. danielsi* in the embryonic sculpture and the general appearance, but in those species the aperture is more oblique than usual in *S. clappi* and the genitalia are conspicuously different. Having dissected a good many individuals of all of these species, I feel confident that the genitalia afford the most reliable specific characters. *S. clappi* is very much like *S. walkeri* in genitalia.

A couple of shells from Station 17½, Camperel Canyon, on the eastern slope of the range, resemble the Agua Caliente form in being light colored. One from Station 17, in the same canyon, is the darkest of all, being nearly a sorghum-brown color, more vinaceous where the cuticle is worn off. The genitalia (Pl. XII, figs. 4, 4*a*) differ from typical *S. clappi* by the longer penis and penis sheath, and the shorter vagina. Length of penis 13, penis-papilla 10, epiphallus 10, flagellum 1, vagina 4½ mm.

A bleached *Sonorella*, No. 105,385, U. S. N. M., collected, or at least sent to Dr. I. Lea in 1860, by H. C. Grovenor, is labelled "Santa Rita Mountains, 6,000 feet above the sea." It is *very thin* and appears under the lens to have been granular. The lip-ends converge, as in *S. clappi*, from which this shell differs by its larger size and less depressed shape; diam. 20.5 mm. It is probably a distinct species related to *S. clappi*, but it is not in condition for description. The spire is broken.

Sonorella granulatissima occidentalis n. subsp. Pl. IX, figs. 7, 7*a*, 7*b*.

Similar in sculpture to *S. granulatissima*, but differing by the narrower last whorl, which is less convex above; the light borders of the chestnut-brown band, and the less depressed spire.

Alt. 12, diam. 19.6 mm.; umbilicus 2.8 mm.; $4\frac{2}{3}$ whorls.

Santa Rita Mountains at Station 17 (Camperel Canyon), on the northeastern flank of Old Baldy. Type No. 112,165, A. N. S. P.

We regret that the jar containing the soft parts of this species proved leaky, and its contents were lost. It seems to be related to *S. granulatissima*, as the sculpture is very similar.

V. Small Ranges and Hills of the Santa Cruz River Valley.

Between Tucson and Nogales and the Santa Rita and Baboquivari Mountains there are many buttes and ranges of hills or small mountains, a few of which we visited, finding in each a special species of *Sonorella* and sometimes a few small shells.

Among the more important ranges which should be investigated we may mention the Tumacacori (or Atascoso) range, an extensive mass of arid looking mountains, extending south to the Mexican line, and probably supporting little but *Sonorella*. They are easily accessible from the Sonora R. R., being about 6 miles from "Siding No. 4." These mountains on the south pass into the Sierra de los Pajaritos, which lie west of Nogales—"a confused mass of rocky crags, peaks, flat-topped mountains with vertical sides, enormous trachyte dykes, steep narrow ridges and deep canyons." They are covered with "a fine growth of oak, juniper and manzanita, while magnificent walnut, sycamore and ash trees line the canyons." Water supply precarious except in the wet seasons. These fine mountains are unknown to the conchologist.

Various species reported from Tucson were certainly brought there from more or less distant localities. *Sonorella granulatissima*, reported by Bartsch, Smiths. Misc. Coll., Vol. 47, p. 193, and *Ashmunella varicifera* Ancey are Huachucan species. The following species were taken in the drift débris of the Santa Cruz River, near Tucson, chiefly above the bridge. The fresh-water shells are mainly fossils, washed out of, or exposed upon the low dirt banks, where the stream has cut down through a former *cienega*. Part of the land shells probably washed in from the Tumamoc and other eastern foothills of the Tucson Range. We found *Bifidaria tuba* and *Thysanophora hornii* on the Tumamoc Hills, and with other minutiæ, in débris washed down from the hills at the hill terminus of Congress St.

Thysanophora hornii (Gabb.).
Holospira ferrissi sanctæcrucis P. and F. (see p. 388).
Zonitoides singleyana (Pils.).
Succinea avara Say.

PUPOIDES MARGINATA (Say).
BIFIDARIA PROCERA CRISTATA P. and V.
" PELLUCIDA HORDEACELLA (Pils.).
" TUBA P. and F.
VERTIGO OVATA Say.
LYMNÆA PARVA Lea.
" OBRUSSA Say.
" BULIMOIDES COCKERELLI P. and F.
PLANORBIS TENUIS Phil.
" CARIBÆUS Orb.
" PARVUS Say.
" ARIZONENSIS P. and F.
PHYSA VIRGATA Gld.
PALUDESTRINA PROTEA (Gld.).
PISIDIUM PAUPERCULUM (Sterki).[6]
" COMPRESSUM Prime (KIRKLANDI Sterki).
ANODONTA DEJECTA Lewis, fossil and recent, fragmentary.

In the drift débris of the Santa Cruz River at Amado's Ranch (not far from the mouth of Sopori Creek) we took the following:

ZONITOIDES SINGLEYANA (Pils.).
" MINUSCULA (Binn.).
PUPOIDES MARGINATA (Say).
BIFIDARIA PELLUCIDA HORDEACELLA (Pils.).
" PERVERSA Sterki.
" PROCERA CRISTATA P. and V. (one specimen).
" PENTODON (Say).
VERTIGO OVATA Say.
VALLONIA PERSPECTIVA Say.
PHYSA HUMEROSA Gld.
" VIRGATA Gld.

On Sopori Creek, five miles west of Amado's Ranch.

THYSANOPHORA HORNII (Gabb).
PUPOIDES MARGINATA (Say).
PHYSA sp. undet.

Sonorella arizonensis (Dall).

Epiphragmophora arizonensis Dall, Proc. U. S. Nat. Mus., XVIII, p. 1, 1895.
Sonorella arizonensis (Dall), Bartsch, Smiths. Misc. Coll., XLVII, p. 198, Pl. 33, fig. 6.

This is a rather globose species with narrow umbilicus, quite unlike anything we found. The type is a bleached specimen found in the Santa Cruz River at Tucson, which no doubt drifted down from above. As no *Sonorella* lives at or near the river level, it must have been washed down from some mountain or rocky hill in the

[6] The species of *Pisidium* in these lists were determined by Mr. E. G. Vanatta.

river valley, and will eventually be found again. Great quantities of the drift débris of the Santa Cruz which we looked over did not produce a second specimen, though minute shells were abundant. Only by a rare chance would so turbulent a stream as the Santa Cruz in flood carry *Sonorella* very far. In its ordinary condition there is a succession of small pools connected, in places, by a slender rivulet; but after heavy rain we have seen turbid water from bank to bank for a brief time.

Sonorella tumamocensis n. sp. Pl. X, figs. 4, 4*a*, 4*b*.

The shell is depressed, umbilicate (umbilicus contained about 6 times in the diameter of the shell), thin, light pinkish cinnamon, fading to whitish on the base, and having indistinct whitish borders above and below the rather narrow chestnut-brown shoulder band. Apical sculpture is of the *hachitana* type, but usually very weak, the initial half-whorl smooth, without the usual radial ripples; the rest of the embryonic shell is marked with a few delicate, interrupted tangential (protractive) threads, on a nearly smooth ground, having weak growth ripples only. The subsequent neanic and last whorls have weak growth lines. Whorls $4\frac{1}{2}$, convex, the last slowly descending in front. Aperture rounded, nearly as high as wide. Peristome thin, the outer and basal margins very narrowly expanded. The columellar lip, in basal view, shows *very little dilation*.

Alt. 10.5, diam. 17.5 mm.; aperture 8.7 x 9.5 mm.; umbilicus 2.8 mm. wide.

Other specimens measure:

Alt. 10.5, diam. 18 mm.
" 9, " 17 "
" 9, " 16 "

Genitalia (Pl. XIII, fig. 5).—The penis is about as long as the vagina, slender in its lower part, somewhat swollen above. Around the base there is a very short sheath of very loose open texture. It contains a slender, slowly tapering papilla about one-third as long as the penis, its surface *closely grooved spirally*, the apex obtuse but small. The epiphallus is slender, terminating in a vestigeal, bud-like flagellum. The retractor muscle is inserted on the epiphallus. Other organs as usual.

Top of the head and back are slate-colored, shading into gray on the sides, whitish towards the edges of the foot. Tail and sole white. Faint lines define the three areas of the sole. Jaw (Pl. XIII, fig. 8) has 3 or 4 very weak ribs.

Tumamoc Hill, near Tucson, Pima Co., Arizona. Types No. 112,245, A. N. S. P., collected by Ferriss, Pilsbry and Daniels, October 1, 1910; topotypes in collections of Ferriss and Daniels. Specimens were taken by Mr. J. C. Blumer under volcanic cliffs on the northeast side of Cat Mountain, in the Tucson Range.

The shell closely resembles *S. eremita* of the Mineral Hill group, but it is much thinner with the peristome decidedly less expanded and the embryonic whorls smoother. The penis is very much longer than in *eremita*. A comparison with the unique type of *S. arizonensis* Dall, kindly made by Dr. Paul Bartsch, shows that that species is quite distinct.

We would be disposed to consider *tumamocensis* a subspecies of *S. rowelli* were it not that in individuals having the shell about the same size as *rowelli* the penis, penis-papilla, epiphallus and vagina are about twice as long; the spermathecal duct remaining about equal in the two species. The shape of the penis-papilla is different, that of *tumamocensis* being longer, slender and tapering. For comparison we have added measurements of the organs of *S. rowelli* to the table on p. 408. The columellar lip dilates much less than in *S. comobabiensis* or *S. sitiens*.

The penis is very much longer, its papilla both absolutely and relatively much shorter than in *S. papagorum*.

The Tumamoc Hills are an outlying spur of the Tucson Range, about a mile from Tucson west of the Santa Cruz River. There are three hills: Tumamoc, 3,092 feet, on the northern slope of which the Desert Botanical Laboratory of the Carnegie Institution of Washington stands; Sentinel, 2,885 feet, and a lower nameless hill of 2,672 feet elevation. The hills are volcanic, formed of an old andesite flow, largely covered by rhyolite (which is the characteristic rock of the Tucson Range) and later flows of basalt.[7] *Sonorella* occurred in great piles of black basalt, on the north slope of Tumamoc Hill, from just below the flat summit down half way to the Desert Laboratory. Most of them were taken not far from the 2,750-foot contour (our Station 35). Living snails are very scarce and hard to get. None were found on the other slopes of Tumamoc Hill, nor could we find them on Sentinel Hill. On the 2,672-foot hill, at the end of Congress St., we took only *Bifidaria tuba*.

[7] Topographic and geological maps of these hills, with accounts of their physical features and vegetation, may be found in the following publications of the Carnegie Institution of Washington: D. T. Macdougal: Botanical features of North American deserts, 1908. Volney M. Spalding: Distribution and movements of desert plants, 1909.

Except for the specimens of *S. tumamocensis*, taken by Mr. Blumer at Cat Mountain, the Tucson Range, about 25 miles long, is not explored for shells.

Sonorella papagorum n. sp. Pl. VIII, figs. 8, 8*a*, 8*b*.

The shell is depressed, umbilicate (the umbilicus contained about 9 times in the diameter of the shell), rather thin, somewhat glossy, light pinkish cinnamon, fading to whitish around the umbilicus, and a trifle pale at the edges of a dark chestnut-brown band at the shoulder. Apical sculpture is of the *hachitana* type, but *very weakly* developed, the initial half-whorl smooth, the rest of the embryonic shell similar to that of *S. tumamocensis*. Subsequent whorls are lightly marked with growth lines. Whorls $4\frac{3}{4}$, convex, the last descending slowly in front. Aperture oblique, rotund-oval. Peristome slightly expanded above, the outer and basal margins well expanded, thin; columellar margin broadly dilated, partly covering the umbilicus.

Alt. 14, diam. 23 mm.; aperture, alt. 11.8, diam. 13.6 mm.; width of umbilicus 2.7 mm.

Genitalia (Pl. XIII, fig. 4).—Penis small and slender, about equal in length to the vagina and of equal calibre throughout. A short, loose sheath envelops its base. The penis-papilla is nearly as long as the penis, very slender, slowly tapering, indistinctly annulate. The slender epiphallus bears the retractor muscle and terminates in a very minute flagellum. Female organs as usual. Jaw (fig. 6) has five or six strong, unequal ribs, or in one specimen four unequal weaker ribs. It is quite variable.

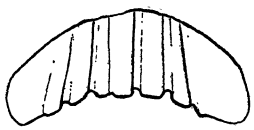

Fig. 6.—Jaw of *Sonorella papagorum*.

The shells show but little variation, excepting size.

Alt. 13.8, diam. 23.5 mm.; aperture 12 x 13.3 mm.
" 12, " 20.5 " " 10 x 11.7 "

Black Mountain, near the mission of San Xavier del Bac, in the Papago Indian Reservation, Pima Co., about 9 miles south of Tucson. Types No. 112,161, A. N. S. P., collected by Pilsbry and Daniels, October 5, 1910.

This shell is less solid than *S. eremita*, with a narrower umbilicus and far weaker apical sculpture.

Black Mountain is a rather remote and isolated outlier of the Tucson Range, which has here its southeastern terminus. It is a long, straight, level-topped ridge, divided by a deep gap into a longer and a shorter mountain. The slopes are everywhere very steep, covered with black basalt, like Tumamoc Hill at Tucson. Slides of this rock occupy a large part of the slopes. Between the slides, which are, of course, barren of vegetation, there is some desert verdure. Ocotillo, mesquite, cat-claw, palo verde, etc., are typical plants, and giant cacti grow on the south side. No agave or sotol were seen. The Sonorellas are found rather deep in the slides. They probably inhabit the whole northern slope, but we worked only a couple of hours, on the north side of the east end, close under the summit. Some hazard attends the hunt in these slides, which are so steep that the heavy rock starts to move on small provocation. Black Mountain, like the rest of the Tucson Range, is very dry. It stands on a plain much lower than the Mineral Hill group and higher than Tucson. The station where *Sonorella* was collected we would roughly estimate as 3,200 or 3,300 feet above the sea.

Sonorella eremita n. sp. Pl. VIII, figs. 7 to 7*e*.

The shell is globose-depressed, umbilicate (the width of umbilicus contained about $6\frac{1}{2}$ times in the diameter of shell), more solid than other species of the same region, glossy, pinkish buff, fading to nearly white around the umbilicus, and having a chestnut-brown shoulder band, without noticeable light borders. The embryonic shell, of about $1\frac{1}{3}$ whorls, has strongly developed sculpture of the *hachitana* type. The initial half-whorl has some radial ripples or wrinkles; then there appears a series of long, protractive threads on the outer two-thirds, meeting shorter forwardly ascending threads on the inner third; the intervals occupied by short radial impressions. The threads are subject to more or less interruption, particularly on the greatest convexity of the whorl. The later whorls are marked with very fine, unequal growth-lines.

The spire is very low, conoidal. Whorls $4\frac{1}{2}$, moderately convex, the last slowly descending in front. The oblique aperture is rounded, but slightly wider than high. Peristome slightly expanded above, the outer and basal margins expanding more, slightly thickened, the margins converging, connected by a very thin parietal film.

Alt. 11.9, diam. 19.3 mm.; umbilicus 3 mm.

West end of San Xavier Hill, Mineral Hill group, about 20 miles S. S. W. of Tucson, Pima Co., Arizona. Types No. 112,161, A. N. S. P., collected by Pilsbry and Daniels, 1910. Topotypes in collections of Ferriss and Daniels.

The top of the head is gray, integument elsewhere cream-tinted. The median area of the sole is whitish, twice as wide as either side area, the latter flesh-tinted.

The genitalia (Pl. XIII, figs. 2, 10).—Penis very small and slender, having a very short, weak basal sheath of a few loose fibres. The papilla is coarsely annulated, very slender and long. The penis-retractor muscle is inserted on the epiphallus, which is extremely slender, not so wide as the vas deferens, but enlarged a trifle where it joins the latter. There is no flagellum. Female organs as usual.

Jaw having four or five unequal ribs, sometimes rather weak (Pl. XIII, figs. 6, 6*a*).

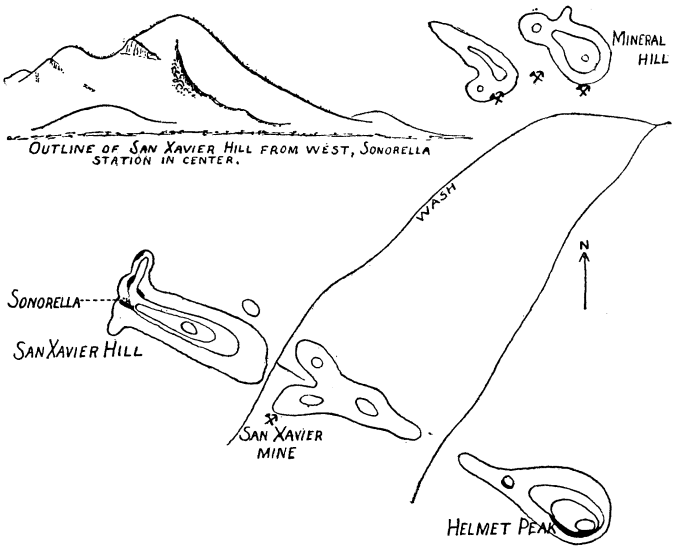

Fig. 7.—Plan of the Mineral Hills, scale 2 inches to a mile, with sketch of the type locality of *Sonorella eremita*.

In the genitalia, as well as the shell, this species resembles *S. papagorum*, but it differs by having a smaller penis and by the very slender epiphallus, which is actually smaller than the vas deferens in several specimens dissected. In *S. tumamocensis* the penis is very much longer. The shell is smaller than *S. papagorum*, with *far more strongly developed apical sculpture* than in any other species of this district. It is also more solid, and, having an aspect of its own, is not likely to be confused with any other *Sonorella* known to us.

The size is quite variable:

Alt. 12.7, diam. 21.3 mm.; whorls $4\frac{1}{2}$.
" 9.9, " 17 "
" 9, " 16 " " $4\frac{1}{3}$.

There was a scalariform specimen among the bones. It measures 13.3 mm. high, 16.6 wide. The normal height for a shell of this diameter should be about 9.5 mm.

The Mineral Hill group, Twin Buttes and Tinaja Hills are much degraded outliers of the Sierrita Mountains. Only the Mineral Hill group has been worked for land snails, though all doubtless have Sonorellas—and very little else.

The Mineral Hills are about 20 miles west of south from Tucson and about 7 miles north of the Sierritas.[8] They stand at the summit of a long slope, rising about 1,000 feet in ten miles from San Xavier del Bac, on a mesa of perhaps 3,600 feet elevation. The xerophytic vegetation extends over the hills, mesquite, cat-claw, palo verde, ocotillo and sotol being the more conspicuous plants, to which may be added tree cacti on southern slopes, and on the mesa many opuntias, cylindropuntias and a few barrel cacti and yuccas. The absence of *Agave* is peculiar. These hills are a favorite resort of rattlesnakes. I got also a coral snake. No mollusks whatever were found on Mineral Hill or Helmet Peak. San Xavier Hill is composed of white subcarboniferous limestone, like the hills southeastward, except at the western end, which is whitish quartz, with a spur to the north of coarse pinkish-gray granite. There is a depression in this end of the hill, between short, low cliffs of white quartz. The cliff towards the south has partly fallen in a tumble of huge blocks with some smaller stone between them. This talus is perhaps 200 feet long to the last scattered blocks, and at the widest 40 feet wide; its lower end about 200 feet above the mesa. In it we found the *Sonorella* described above. "Bones" were abundant, but living snails extremely scarce, and confined to the deeper portions of the talus, between the piled-up quartz blocks. The entire range of this species is not much greater than the area occupied by a moderate-sized house. In this insignificant fastness it is making a last stand against extermination.

We found no snails in a hill covered with granite boulders about 3 miles north of west from San Xavier Hill. It is possible, though unlikely, that some insignificant colony may exist there.

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[8] While there we occupied a comfortable camp at the copper mine of Mr. L. D. Chilson, of Tucson, whose courtesy we would here acknowledge.

Sonorella sitiens n. sp. Pl. VIII, figs. 5 to 5*c*.

The shell is depressed, umbilicate (the width of umbilicus contained nine to ten times in the diameter of the shell), rather thin, cinnamon colored (varying in tone), paler around the umbilicus, encircled by a chestnut-brown band at the shoulder, bordered with a white band above and below. Surface somewhat glossy. The initial fourth of a whorl is smooth; the rest of the embryonic shell has very fine, anastomosing and interrupted radial wrinkles, and on some specimens there are the faintest traces of spiral threads. The neanic and last whorls are marked with delicate growth lines. Spire low; whorls $4\frac{1}{2}$, convex, the last slowly descending in front. Aperture oblique, rounded oval. Peristome thin, the upper margin hardly expanded, outer and basal margin, a little expanding.

Alt. 11, diam. 20 mm.; aperture, alt. 10, diam. 12 mm.

The back, top and sides of head are slate colored, the tail and a wide band above the foot edges whitish.

Genitalia (Pl. XIII, fig. 3).—The penis is swollen distally, becoming narrow in its basal half, which is enveloped in a muscular sheath, the outer edge of which is attached to the end of the epiphallus. The *penis-papilla is extremely short* and wide, cylindric, with a few annular corrugations and a shortly conic end. The epiphallus is slender, swollen at its distal end, without trace of a flagellum. The lower part of the vagina is very stout. Other organs as usual.

Jaw (Pl. XIII, fig. 7) has 8 strong, narrow ribs.

Northwestern end of Las Gijas above Las Gijas Mine, Pima Co., Arizona. Types No. 112,158, A. N. S. P., taken by Ferriss and Pilsbry, September 27, 1910.

The shell is less solid than *S. eremita*, the aperture decidedly larger, the umbilicus smaller. The color also is darker. It differs from *eremita* conspicuously in the genitalia, the penis of *S. sitiens* being provided with a sheath of half its length, and the papilla being extremely short and stout, while in *S. eremita* the sheath is represented only by a few loose muscular fibres at the base, and the papilla is very slender and comparatively long. No other *Sonorella* known has a penis-papilla like that of *S. sitiens*. Several specimens dissected are entirely similar in genitalia.

The spire is very low in most of the specimens, but in one (Pl. VIII, fig. 5*c*) it is more conic. In this shell the white borders of the shoulder band are very narrow. It measures, alt. 12, diam. 18.5 mm., aperture 9.5 mm. high, 10.8 wide.

Five other adult shells measure:

Alt. 11, diam. 19 mm.; aperture 9.9 x 11.25 mm.
" 11.3, " 19 " " 9.9 x 11 "
" 10.8, " 18.8 " " 9.9 x 11 "
" 10.3, " 18 " " 9.2 x 10.5 "
" 10, " 17.8 " " 9 x 10.3 "

The most closely related species seems to be *S. rowelli*. This, however, has a larger penis-papilla and a slightly wider umbilicus.

The low and inconspicuous range Las Gijas (the Quartz Hills) lies south of the well-known landmark Cerro Colorado, and west of the northern end of the Tumacacori Range. At the northwest end there is a mine, and a ranch building stands on the bank of a small stream, the Gija Wash. The hill above the mine is strewn with rounded boulders of coarse-grained granite, weathering to angular gravel. Most of the loose rock is too massive to move, so that suitable situations for snails are scarce. We found the first Sonorellas on the slope above the mine. Working up over the rounded top of the hill and along the ridge a half mile south we crossed a low rock dyke, where a few more shells and a large colubrine snake were taken. None were found among the rocks at the head of the canyon east of this ridge. The other hills at this end of the range are rounded, grassy, with little rock. On top there is much sotol, ocotillo, a few cacti, etc. We found the pygmy *Agave parviflora* here. It was not seen elsewhere.

In the débris of the Gija Wash we found *Thysanophora hornii* (Gabb), *Zonitoides minuscula* (Binn.) and *Bifidaria pelleucida hordeacella* (Pils.).

Measurements of the genitalia of the preceding species are here given together. The species identified as *S. rowelli* (Nc.) in these PROCEEDINGS for 1905 being added for comparison.

	Penis.	Penis-papilla.	Epiphallus.	Flagellum.	Vagina.	Spermatheca and duct.	Diameter of shell.	Museum number.
S. tumamocensis	10	3.7	10	Trace	10.7	23.5	17.5	103101
S. papagorum	6	5	7	0.5	7	28.5	23	103099
S. eremita	4.2	2.9	.....	0	5.5	25	19	103100
"	3.5	2.7	4	0	6	25	.....	"
"	4.4	.....	4.5	0	3.5	28	.....	"
S. sitiens	6	1	5	0	5	.....	20	103102
"	7	1	.....	0	5	25	.....	"
S. rowelli, Sanfords	5	2	5	Trace	5.3	20	17	83273
S. rowelli, Patagonia Mts	4	.....	.....	0	4.5	.....	15.4	83268

Sonorella sitiens arida n. subsp. Pl. VIII, figs. 6, 6*a*, 6*b*.

The shell resembles *S. sitiens*, but differs in these features: the umbilicus is decidedly wider, its diameter contained 6 to nearly 7 times in that of the shell; the color is paler; the aperture is noticeably smaller. The embryonic $1\frac{1}{2}$ whorls show distinct spirally protractive threads in young individuals.

Alt. 10.8, diam. 19 mm.; aperture, alt. 9, diam. 10.2 mm.; umbilicus 3 mm.

Alt. 10, diam. 18.5 mm.; aperture, alt. 9, diam. 10 mm.; umbilicus 3 mm.

Alt. 10.25, diam. 19.9 mm.; aperture, alt. 9.9, diam. 11 mm.; umbilicus 2.9 mm.

Cerro Colorado, around the base of a conspicuous crag at the southeastern end of the range. Types No. 112,160, A. N. S. P., collected by Pilsbry and Ferriss, September 28, 1910.

The first two measurements are of cotypes from the south side of the crag. The third specimen measured is the only adult shell taken on the north side of the crag, perhaps a hundred feet higher.

This form stands very close to *S. sitiens*, yet the difference in the size of umbilicus is constant in the small series examined; no communication between the colonies of Cerro Colorado and Las Gijas can have taken place for a very long period, so that in the present state of our knowledge it seems proper to keep the forms of the two hill-groups subspecifically separate.

Unfortunately, no living examples were found, so that the anatomical characterization of the subspecies remains to be worked out.

The Cerro Colorado ("Red Hill") lies a few hours' travel north of Las Gijas. The northern slopes are grassy and rounded, but west and south it is carved into bold, fantastic crags and pinnacles of dull red rhyolite—a landmark which catches the eye for a long distance.

Our work here was brief. Scarcely an hour was spent around a crag which stands at the southeastern extremity, about two miles from the Cerro Colorado Mine on the Aravaca Road. Here the *Sonorella* described above was taken, only a few dead specimens. No doubt, the cliffs westward, higher up, would yield better results, though little can be expected in such a dry situation. Neighboring low crags of milk-white quartz, at a lower level southward, were found barren.

Sonorella sitiens comobabiensis n. subsp.

The shell is similar to *S. sitiens* in general shape, its width contained about 9 times in the greatest diameter of the shell. It is smaller within, and enlarges more in the last whorl than that of *S. tuma-*

mocensis, but the enlargement is largely concealed by the overhanging and dilated columellar lip. It is light pinkish cinnamon, fading to white around the umbilicus, usually with a white streak on the last whorl, left by a former resting stage, and with white bands above and below the rather wide chestnut-brown shoulder band. The apical sculpture is of the *sitiens* type, but some interrupted, descending spiral threads are visible on the best examples; subsequent whorls are lightly marked with growth lines. The aperture is larger than in *S. tumamocensis*, but less ample than that of *S. vesperus*. The peristome expands distinctly, though narrowly.

Alt. 10.1, diam. 18, longest axis of aperture 10.1 mm.; $4\frac{3}{4}$ whorls.
" 10.8, " 19, " " " " 11.5 " $4\frac{3}{4}$ "
" 9.7, " 17.4, " " " " 10.3 " $4\frac{1}{2}$ "

Comobabi Mountains, at the base of a cliff on the north side of the highest part of the range, elevation about 4,000 feet. Type and paratypes No. 112,252, A. N. S. P., other paratypes in Ferriss collection. Also taken in the Cababi Hills, about 10 miles westward, in a slide of volcanic rock on the north side of the highest peak, about 3,000 feet elevation. All were collected by Mr. J. C. Blumer, of Tucson, in the course of botanical exploration.

About 120 specimens were collected, some of them showing the surface and color unimpaired, though all were dead shells. We are therefore unable to give any information on the soft parts. The shell is very much like *S. sitiens* of Las Gijas, further south, and east of the Baboquivari Range; but on account of the wide separation of the localities, it is likely to be subspecifically or even specifically distinct.

The Comobabi Mountains form a short range, about 75 miles west of Tucson. The Cababi Hills, immediately west, and the Qui-i-tomoc Hills, a short distance south, are parts of the same group. It is evidently rich in shells, as Mr. Blumer found *S. s. comobabiensis* on the highest peaks (near the south end) of both Comobabi and Cababi, and a form which we cannot distinguish from *S. vespertina* on the north side of the largest peak of the Qui-i-tomoc Hills. Somewhere in the Cababi Mountains, the exact location not given, Mr. Frank Cole collected two forms, which we provisionally refer to *S. ashmuni* as varieties; one of them is the largest *Sonorella* known.

Sonorella ashmuni capax n. subsp. Pl. X, figs. 7, 7*a*, 7*b*.

The shell is umbilicate, the umbilicus very narrow within, but in the last half-whorl widening to about three times its former width,

oblong, contained between seven and eight times in the diameter of the shell. Avellaneous in color, paler around the umbilicus and slightly so on both sides of the chestnut-brown shoulder band. Surface glossy, lightly striate, the embryonic shell of $1\frac{2}{3}$ whorls with *S. hachitana* sculpture.

Whorls 5, slowly widening, the last whorl very broad and capacious, rather strongly descending to the aperture. The aperture is very large, oblique, the peristome well expanded except near the upper termination; margins converging, joined by a thin callus.

Alt. 15.7, diam. 28.4 mm.; umbilicus 3.7 mm.; aperture 16.4 mm. wide, 13.7 high.

Cababi Mountains (about 75 miles west of Tucson), collected by Frank Cole, March, 1915. Type No. 112,253, A. N. S. P., cotypes in Ferriss collection.

This is one of the largest species, very much resembling *S. ashmuni* Bartsch, from Richinbar, Yavapai Co., which has a slightly smaller aperture. As the localities are several hundred miles apart and separated by the depression of the Gila River, they will probably turn out to be distinct when the genitalia of both are examined; but as no differences which could reasonably be called specific appear in a close comparison of the types, we rank the southern form as a subspecies.

The nine specimens collected measure 28.4, 27.9, 27.8, 25.5, 24.8, 24.6, 24.5, 24, 23.9 mm. diameter, being therefore variable in size.

Sonorella ashmuni ambigua n. subsp. Pl. X, figs. 6, 6*a*, 6*b*.

The shell is smaller than *S. a. capax* (diameter 20.9 to 23.4 mm.) with the last whorl widening somewhat less, the aperture more rounded.

Alt. 13.5, diam. 22.5 mm.; umbilicus 3 mm.; aperture 12.2 mm. wide, 11 high. Whorls $4\frac{1}{2}$.

Cababi Mountains; No. 112,254 sent with the preceding, but whether collected in the same place is not known. They were taken in March, 1914, by Mr. Frank Cole, Mr. Ferriss' guide in 1913.

Thirty-two specimens measure as follows in diameter: 20.9, 21 (2), 21.1, 21.3 (2), 21.4 (2), 21.5, 21.6 (2), 21.7 (2), 21.8, 22 (5), 22.2 (2), 22.3, 22.4, 22.5 (3), 22.6, 22.7, 23, 23.2, 23.3, 23.4.

We are in some doubt about the status of this form, but it is readily separable from *S. a. capax* in the series seen. The genitalia when examined will no doubt clear up the uncertainty.

VI. The Baboquivari Mountains.

We had not intended at first to visit the Baboquivaris. From our camp, above 7,000 feet in the Santa Ritas, the long ridge, sixty miles distant, bounded the western horizon. We could see the wonderful obelisk of Baboquivari Peak catch the morning sun while the great valley between slept in dusk. At evening it stood silhouetted, velvet black, between the purple valley and flaming sky. To visit this range, beyond which there is no water, became an obsession, and finally we made the two-day journey by wagon, camping midway on Sopori Creek, where there was a little stagnant water for the horses.

The Baboquivari Range is a single, long, north and south ridge with numerous short lateral spurs. Its chief landmark, Baboquivari Peak, is a huge obelisk of dull red rhyolite, standing on the main axis of the range, flat topped, its sides practically vertical. The foothills and lower slopes of the range have many barrel cacti, opuntias, agaves, very few giant cacti. The lower courses of the canyons are green with mesquite and cat-claw. The higher mountains are grassy and lack large cacti; only a flat *Mamillaria* and the little rainbow cactus were noticed. There is some scattering oak, size of a peach tree, on western and northern slopes, and very few stunted pinyons around the high crags. The herbaceous plants are chiefly the same as in the Santa Ritas. Sycamore Canyon has a richer sylva—buttonwood, walnut, hackberry, a fine dark-leaved species of oak, etc. There is water in Oro Fino and Sycamore Canyons, and we found some also near the head of Thomas Canyon, about half a mile below the peak. Near the mouth of Sycamore there was in 1910 a foresters' house (which we occupied), a corral and a pump. Much further up there is running water. Our collecting stations, enumerated below, are shown on the accompanying sketch map.[9]

The following collecting stations were found:

Station 21. Mt. Mildred, north side of the butte at summit of the talus slope.

[9] We are indebted to Professor R. H. Forbes, of the University of Arizona, for information correcting the names we had heard of the canyons. Sycamore Canyon is also known as Brown's or Wasson and Brown's Canyon. Sabino Otero has for many years ranged cattle in this canyon, and from this some persons have called it Otero Canyon. We were also given the name Baboquivari Canyon for Oro Fino Canyon. No topographic map has been published, so that hasty note-book sketches made by one of us in course of a long day's tramp from Oro Fino Canyon to the Peak and down to camp in Sycamore Canyon, have been utilized to locate our type localities.

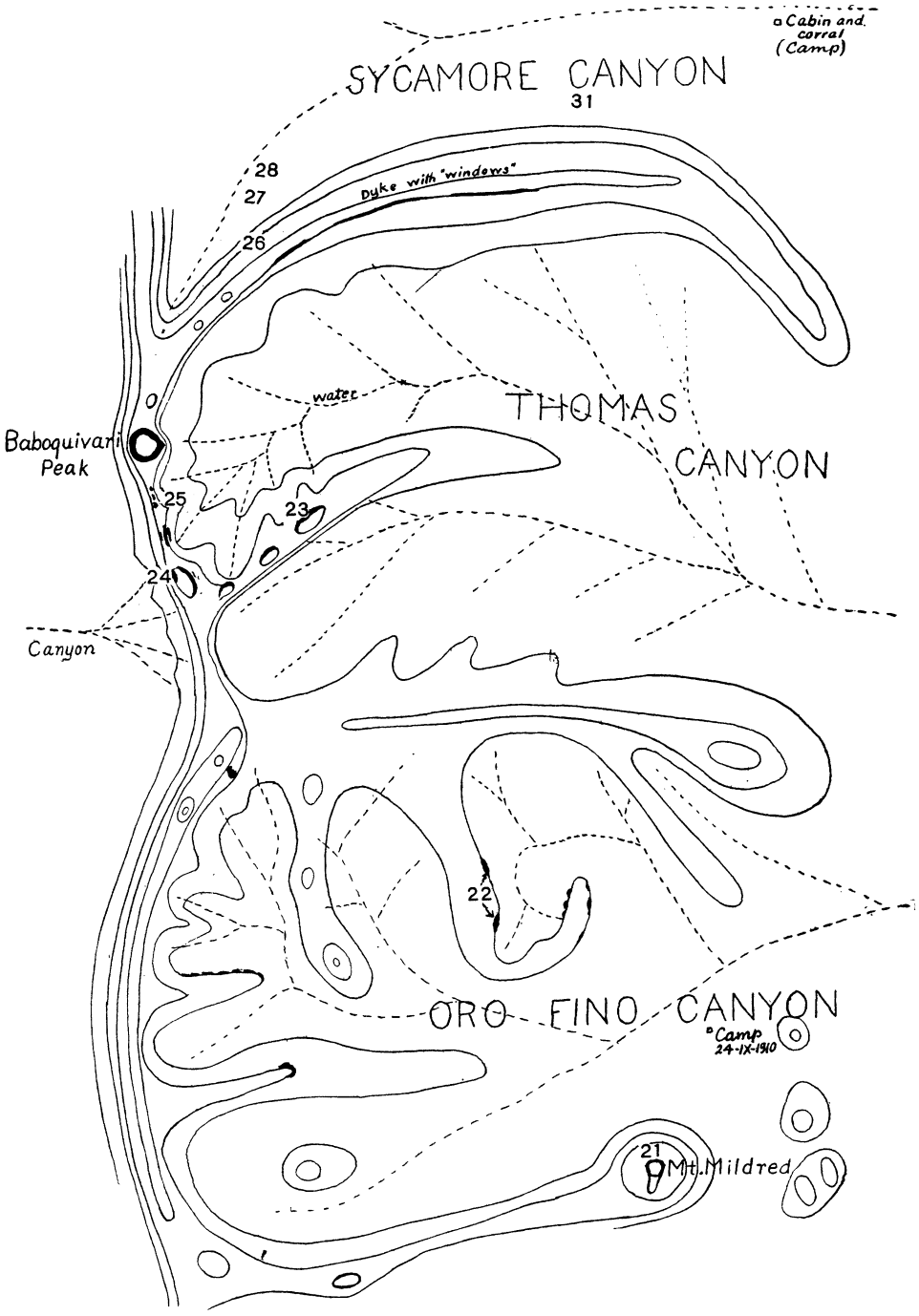


Fig. 8.—Map of a section of the Baboquivari Range, to show type localities and other collecting stations.

Station 22. Low crags in the northern part of Oro Fino Canyon.

Station 23. Crags on the southern rim of the northern branch of Thomas Canyon.

Station 24. West side of the main ridge near summit, south of Baboquivari Peak. *Vitrea indentata umbilicata* and *Sonorella vespertina.*

Station 25. East side of ridge, about half a mile from the peak.

Station 26. Near the southwestern head of Sycamore Canyon, between one and two hundred yards below the summit of the Thomas-Sycamore ridge, in a rock "slide."

Station 27. About 1,000 feet below Station 26, near the bottom of the canyon.

Station 28. Not far below Station 27.

Station 29. Bed of upper Sycamore Canyon, about a mile above the foresters' cabin, and not far above the dam.

Station 30. Creek in Sycamore Canyon (a small *Physa*, not determined with certainty, was the only fresh-water shell found at this station).

Station 31. Sycamore Canyon, about 3 miles up its bed, and $\frac{3}{4}$ mile up a southwestern branch ravine. *Succinea avara* Say and *Sonorella baboquivariensis* only.

Sonorella vespertina n. sp. Pl. X, figs. 5, 5*a*, 5*b*.

The shell is umbilicate (width of umbilicus contained 9 or 10 times in diameter of the shell); cinnamon, fading to whitish around the umbilicus, and with white bands above and below the chestnut-brown shoulder band. Surface glossy, the initial half-whorl having some radial wrinkles, the rest of the embryonic shell without any distinct sculpture, though there is some extremely indistinct radial roughness, stronger near the suture. In fresh young shells of $2\frac{1}{2}$ whorls the surface of the last embryonic and first neanic whorls is densely set with very short hairs, extending also over the base. These are fugacious, lost with further growth. The later whorls are marked with the usual growth lines. Whorls $4\frac{1}{2}$, the last rapidly widening, rather steeply descending close to the aperture. Peristome narrowly expanded on the outer and basal margins, dilated and reflexed at the columellar insertion.

Height 11, diam. 19.8 mm. (type).
" 11.3, " 20 "
" 10, " 18 " $4\frac{1}{3}$ whorls.

Genitalia (Pl. XIII, fig. 9).—The penis is very small and tapers distally to the epiphallus, the long penial retractor being inserted on the latter. The flagellum (*fl.*) is represented by a minute bud or a slight swelling. The penis-papilla (fig. 9, *pp.*) is slender, tapering,

and weakly annular. The vagina is slender and long. Free vas deferens very long. The organs of two individuals measure:

Penis.	Papilla.	Epiphallus.	Vagina.
3.2	2.5	5.5	5.5 mm.
3	2.5	7	5.5 mm.

Baboquivari Mountains, at Station 24, on the west side of the ridge, close to the summit, a half-mile south of Baboquivari Peak. Type No. 111,554, A. N. S. P., topotypes in collections of Ferriss and Daniels. Also on the north side of the highest peak of the Qui-i-tomoc Hills, J. C. Blumer.

This species is readily distinguished from *S. baboquivariensis* by the wider umbilicus, smaller aperture, the shorter, steeper descent of the last whorl to the aperture, and the absence of distinct sculpture on the embryonic whorl; also by the very different genitalia.

By the small penis and slender, tapering penis-papilla, *S. vespertina* is closely related to *S. tumamocensis* and *S. eremita*. In shell characters it comes very close to *S. sitiens*, which differs by the form of its penis-papilla.

S. vespertina was found at our only collecting station west of the summit of the range, but it occurred there in considerable abundance. Over 100 living individuals and numerous "bones" were taken by two of us in about three-quarters of an hour, in the course of our tramp from camp in Oro Fino Canyon to the peak and down to camp in Sycamore Canyon.

The specimens taken in the Qui-i-tomoc Hills have not been dissected, but we cannot distinguish the shells from the Baboquivari *vespertina*.

Sonorella baboquivariensis n. sp. Pl. X, figs. 1 to 2*b*.

The shell is very narrowly umbilicate, globose-depressed, thin, glossy, cinnamon or sayal brown, fading or whitish around the umbilicus and on both sides of the broad chestnut-brown shoulder band. First third of a whorl smooth, the following whorl with sculpture of irregular radial wrinkles, over which run spiral, slowly descending, irregular threads; later whorls marked with fine growth lines as usual. Whorls $4\frac{1}{2}$, the last very wide, its last fourth slowly and rather deeply descending. *The aperture is very large*, strongly oblique. Peristome narrowly expanding throughout, the columellar margin brown-edged, broadly dilated and reflexed half over the umbilicus. The parietal callus has an opaque, pale brown edge.

Height 13.2, diam. 21 mm.

Genitalia (Pl. XIII, fig. 1).—The penis is long, the distal fourth

enlarged, the rest slender. The basal third or less is sheathed, the sheath composed of firm, circular muscles. The papilla (fig. 1, *pp.*) is cylindric, with a conic, glandiform end. The retractor muscle is inserted on the epiphallus, which is nearly as long as the penis, and bears a short flagellum. The vagina is about three-fourths as long as the penis. In two individuals the organs measure, in mm.:

Station.	Penis.	Papilla.	Epiphallus.	Flagellum.	Vagina.	Diam. shell.
25	12	3	11	0.75	9	21
22	10	2.7	8.5	0.75	8.2	19

Baboquivari Mountains, the types No. 111,549, A. N. S. P., from Station 25, in the head of Thomas Canyon about half a mile from Baboquivari Peak. Also at Station 23, at the northern bases of crags at summit of the spur which divides Thomas Canyon. In Sycamore Canyon, at Station 26, in a slide on the ridge of the head branch, about 300 feet or more below the summit; Station 27, about 1,000 feet lower, near bed of canyon; Station 28, still lower, and Station 31, further down the canyon, low on the south side.

In Oro Fino Canyon it was taken at Station 21, at the foot of the cliffs on north side of Mount Mildred, a conspicuous butte at the southern side of the mouth of the canyon; also Station 22, among low crags near the north side of the canyon.

This is the common species of the Baboquivaris throughout the short section of the range which we explored. It is distinguished by having a larger aperture than any other *Sonorella* known. The rather long penis with a strong basal sheath and a papilla of very peculiar and characteristic shape are diagnostic of the soft anatomy, and confirmed in a number of individuals from several stations.

All of the stations are on the eastern watershed of the range. The only collecting station on the western slope (24) had a quite different Sonorella, *S. vespertina.*

The size is smaller in Oro Fino Canyon. At Station 22 the shells are decidedly more solid and more opaque than the types. Height 12, diam. 18 mm. to height 13, diam. 19.5 mm.; $4\frac{1}{2}$ whorls. Soft anatomy is typical.

Specimens from high on the ridge near the head of Sycamore Canyon, Station 26, are also rather small, diam. 18 to 19.3 mm. Near the bottom of the canyon, at Station 27, the shells measure 19 to

21 mm. At Station 28, still lower, the range in diameter is from 17 to 20 mm. At Station 31, much nearer the mouth of the canyon, the shells are about typical.

Sonorella baboquivariensis depressa n. subsp. Pl. X, figs. 3, 3*a*, 3*b*.

The shell is more depressed than typical *baboquivariensis* with the umbilicus decidedly more widely open; aperture smaller. Alt. 9.8, diam. 17.7 mm.

Baboquivari Mountains, low in upper Sycamore Canyon, Station 29. Type No. 111,559, A. N. S. P.

Explanation of Plates VIII to XV.

Plate VIII.—Figs. 1–1*b*.—*Sonorella dragoonensis*. Type. Station 28, Dragoon Mountains. No. 103,094.
Figs. 2–2*b*.—*Sonorella apache*. Type. Station 9. No. 111,529.
Figs. 3–3*b*.—*Sonorella ferrissi*. Type. Station 38. No. 103,097.
Figs. 4–4*b*.—*Sonorella bartschi*. Type. Station 1, Mule Mountains. No. 103,095.
Figs. 5–5*c*.—*Sonorella sitiens*. Type. Las Gijas. No. 112,158.
Figs. 6–6*b*. *Sonorella sitiens arida*. Type. Cerro Colorado. No. 112,160.
Figs. 7–7*e*.—*Sonorella eremita*. Type. Mineral Hills. No. 112,159.
Figs. 8–8*b*.—*Sonorella papagorum*. Type. Black Mountain. No. 112,161.

Plate IX.—Figs. 1–1*b*.—*Sonorella santaritana*. Type. Station 5. Santa Rita Mountains. No. 112,105.
Figs. 2–2*b*.—*Sonorella santaritana*. Station 5. No. 112,107.
Fig. 3.—*Sonorella santaritana*. Albino. Station 5. No. 112,106.
Figs. 4–4*b*.—*Sonorella walkeri*. Type. Station 5. No. 112,164.
Figs. 5–5*b*.—*Sonorella walkeri aguacalientensis*. Type. Station 2. No. 112,162.
Figs. 6–6*b*.—*Sonorella walkeri aguacalientensis*. Station 1. No. 112,166.
Figs. 7–7*b*.—*Sonorella granulatissima occidentalis*. Type. Station 17. No. 112,165.
Figs. 8–8*b*.—*Sonorella clappi*. Type. Station 8. No. 112,163.

Plate X.—Figs. 1–1*e*.—*Sonorella baboquivariensis*. Types. Station 25, Baboquivari Mountains. No. 111,549.
Figs. 2–2*b*.—*Sonorella baboquivariensis*. Station 22. No. 111,560.
Figs. 3–3*b*.—*Sonorella baboquivariensis depressa*. Types. Station 29. No. 111,559.
Figs. 4–4*b*.—*Sonorella tumamocensis*. Type. No. 112,245.
Figs. 5–5*b*.—*Sonorella vespertina*. Type. Station 24. No. 111,554.
Figs. 6–6*b*.—*Sonorella ashmuni ambigua*. Type. No. 112,254.
Figs. 7–7*b*.—*Sonorella ashmuni capax*. Type. No. 112,253.

Plate XI.—Fig. 1.—*Sonorella bartschi* n. sp. Genitalia. No. 103,095, A. N. S. P.
Fig. 1*a*.—Penis-papilla of same.
Figs. 1*b*, 1*c*.—Jaws of two topotypes. No. 103,095.
Fig. 2.—*Sonorella bartschi*, variety. Genitalia. Near Warren, Arizona.
Fig. 2*a*.—Penis-papilla of same.
Fig. 2*b*.—Jaw of same.
Fig. 3.—*Sonorella ferrissi* n. sp. Genitalia.
Fig. 3*a*.—Penis-papilla of the same.
Fig. 4.—*Sonorella dragoonensis*, n. sp. Genitalia. No. 103,093.
Fig. 4*a*.—Penis slit open showing the penis-papilla of same.
Fig. 5.—*Sonorella apache* n. sp. Genitalia.

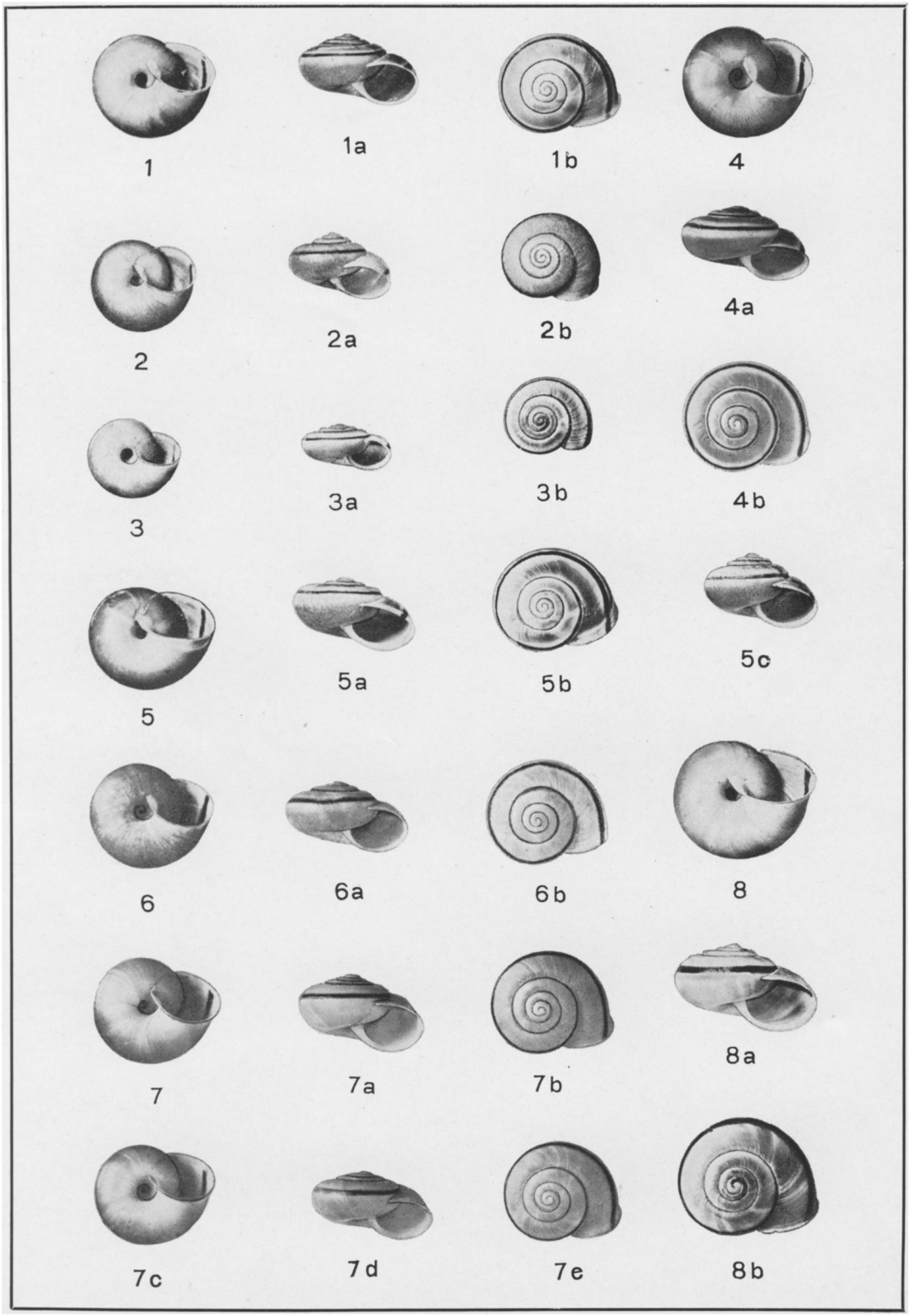
Fig. 5*a*.—Penis-papilla of the same.
Fig. 5*b*.—Median transverse section of the penis-papilla.
Fig. 5*c*.—Upper end of the penis-papilla opened to show the conic nipple in the apex of the cavity.

PLATE XII.—Figs. 1, 1*a*.—*Sonorella walkeri*. Genitalia and detail of penis-papilla, epiphallus and flagellum. Station 8, Santa Rita Mountains.
Fig. 2.—*Sonorella walkeri*. Genitalia. Station 5, Walnut Canyon, Santa Rita Mountains.
Fig. 3.—*Sonorella walkeri*. Genitalia. Station 5.
Figs. 4, 4*a*.—*Sonorella clappi* var. Genitalia and detail of penis-papilla, epiphallus and flagellum. Station 17, Santa Rita Mountains.
Figs. 5, 5*a*.—*Sonorella walkeri*. Genitalia and detail of penis-papilla, epiphallus and flagellum. Station 15.
Fig. 6.—*Sonorella clappi*. Genitalia. Station 8.
Fig. 7.—*Sonorella clappi*. Genitalia. Station 12.

PLATE XIII.—Fig. 1.—*Sonorella baboquivariensis*. Genitalia and detail of penis-papilla. Station 25, Baboquivari Mountains.
Figs. 2, 10.—*Sonorella eremita*. Genitalia of two individuals of the type lot, No. 103,100.
Fig. 3.—*Sonorella sitiens*. Genitalia and detail of penis-papilla, and epiphallus of a topotype. No. 103,102.
Fig. 4.—*Soronella papagorum*. Genitalia and detail of penis-papilla. No. 103,099.
Fig. 5.—*Sonorella tumamocensis*. Genitalia and detail of penis-papilla.
Figs. 6, 6*a*.—*Sonorella eremita*. Jaws of two individuals.
Fig. 7.—*Sonorella sitiens*. Jaw of type. No. 103,102.
Fig. 8.—*Sonorella tumamocensis*. Jaw of types. No. 103,101.
Fig. 9.—*Sonorella vespertina*. Terminal ducts of genitalia with detail of end of the penis-papilla. Cotype.
Fig. 10.—*Sonorella eremita*. Terminal ducts of genitalia. No. 103,100.

PLATE XIV.—Figs. 1–1*b*.—*Holospira danielsi*. Type and paratypes. Tweed Canyon, Station 2. No. 112,199.
Figs. 2–2*c*.—*H. danielsi*. Station 39. No. 112,198.
Figs. 3, 3*a*.—*H. danielsi*. Station 18. No. 112,195.
Figs. 4–4*b*.—*H. danielsi*, variety. Station 12. No. 112,196.
Figs. 5, 5*a*.—*H. danielsi*, variety (?) Station 40. No. 103,092.
Fig. 6.—*Holospira campestris cochisei*. Station 21. No. 112,218.
Figs. 7–7*f*.—*Holospira campestris cochisei*. Cotypes. Station 16. Figs. 7*d*, 7*e* opened to show the internal lamellæ. No. 112,219.
Figs. 8–8*b*.—*Holospira campestris cochisei*. Station 27. No. 112,220.

PLATE XV.—Figs. 1–1*d*.—*Holospira campestris*. Type and paratypes. Station 26, Dragoon Mountains. No. 112,214.
Fig. 2.—*H. campestris*. Station 25, Dragoon Mountains. No. 112,215.
Figs. 3–3*b*.—*Holospira millestriata*. Type and paratypes. Station 7, Dragoon Mountains. No. 112,225.
Figs. 4, 4*a*.—*Holospira millestriata*. Station 36, Dragoon Mountains. No. 112,227.
Figs. 5–5*c*.—*Holospira millestriata*. Station 37, Dragoon Mountains. No. 122,235.
Figs. 6–6*b*.—*Holospira ferrissi fossor*. Type (fig. 6*b*) and paratypes, near Warren, Arizona. No. 112,238.
Fig. 7.—*Holospira ferrissi sanctæcrucis*. Type. Santa Cruz R., Tucson, Arizona. No. 112,239.
Figs. 8–8*e*.—*Holospira arizonensis mularis*. Type and paratypes. Near Bisbee, Arizona. No. 112,236.



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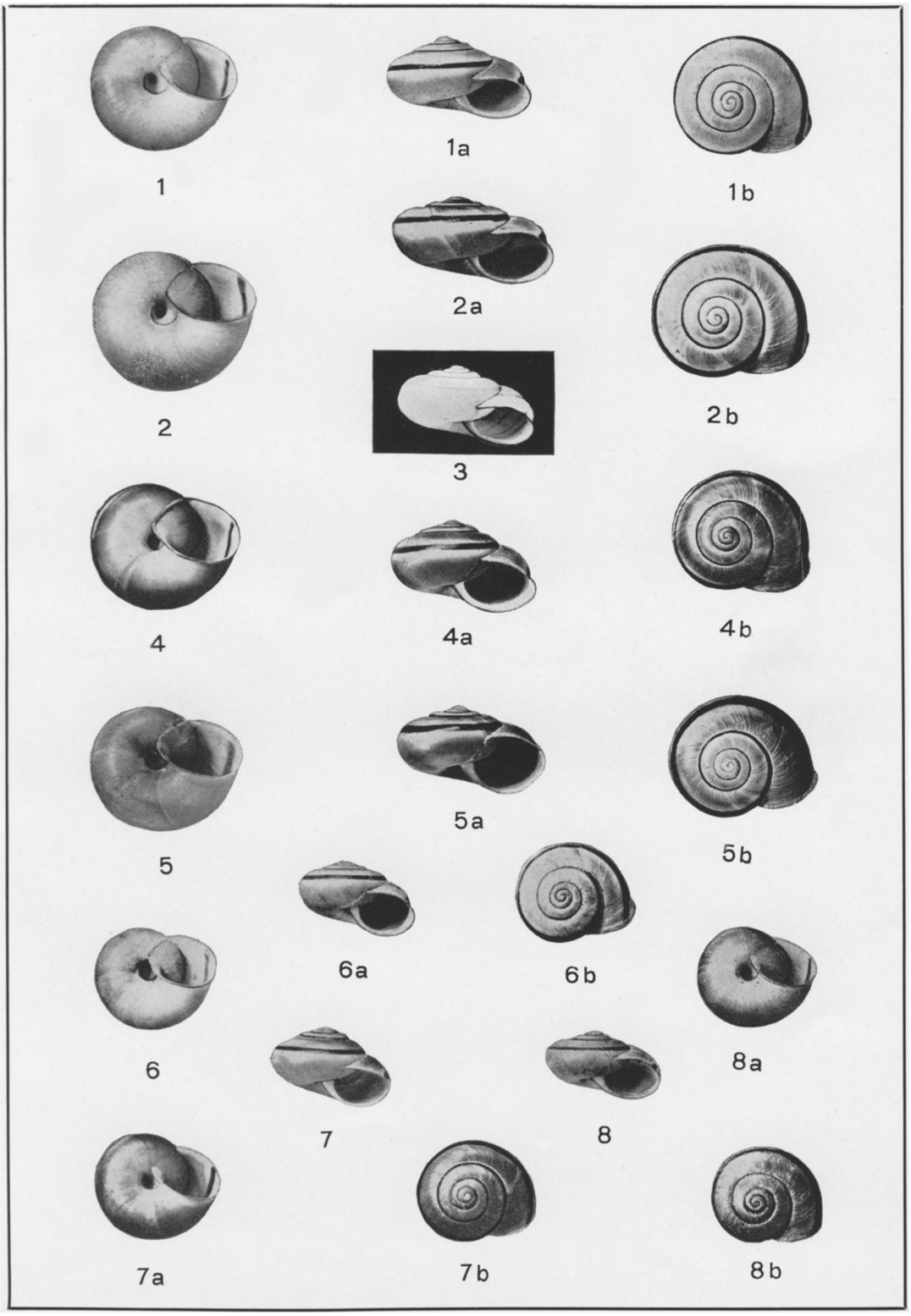

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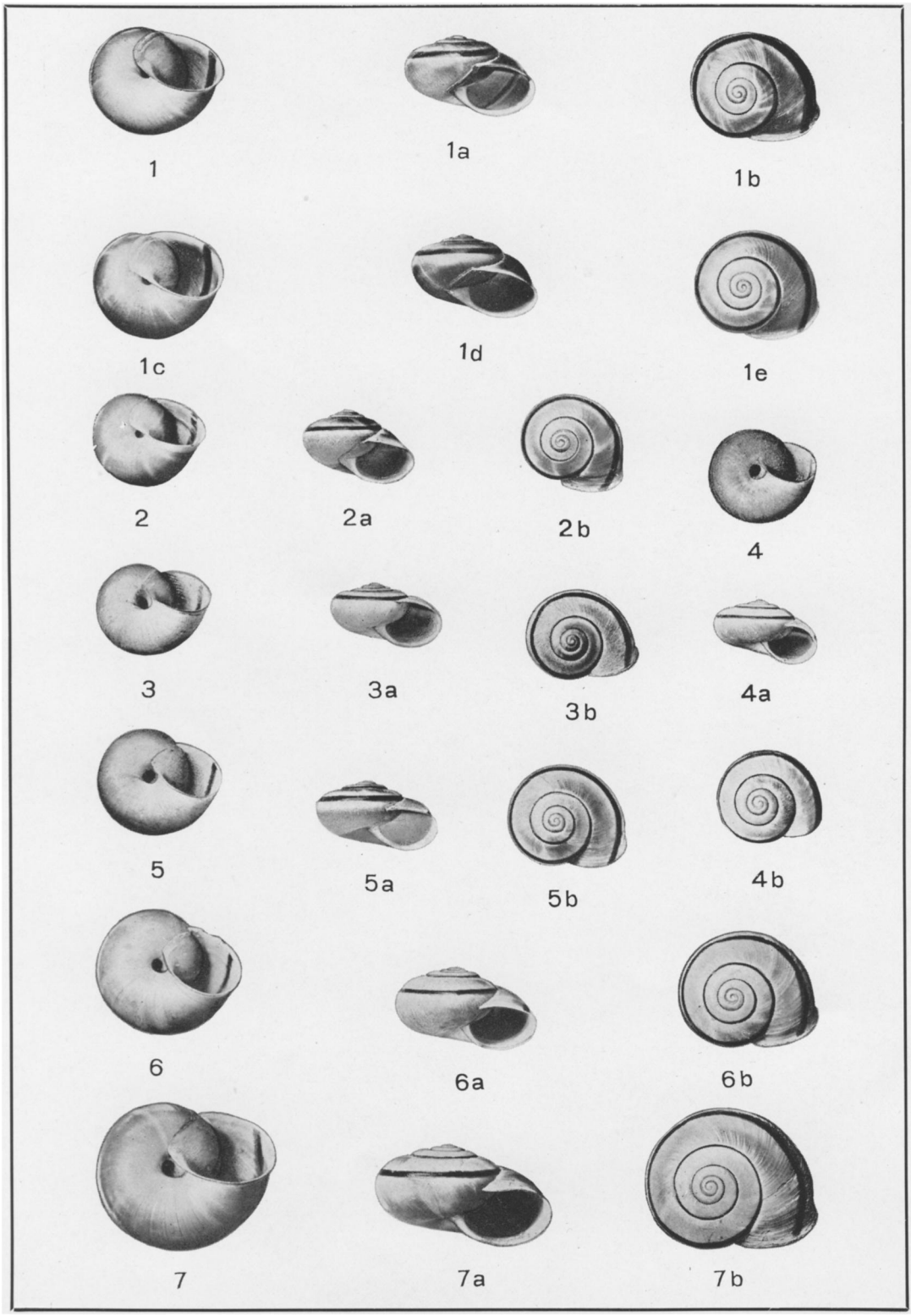

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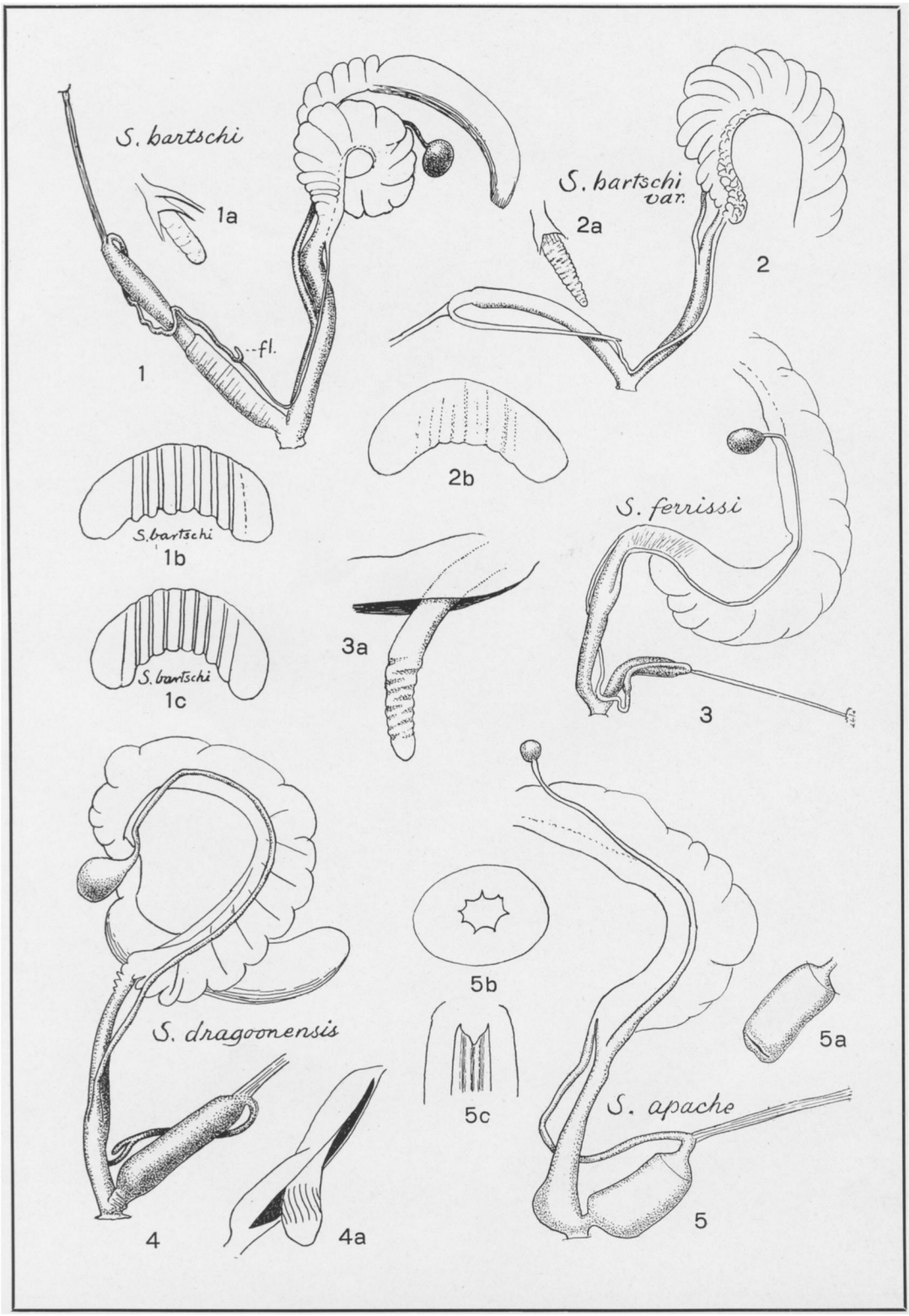

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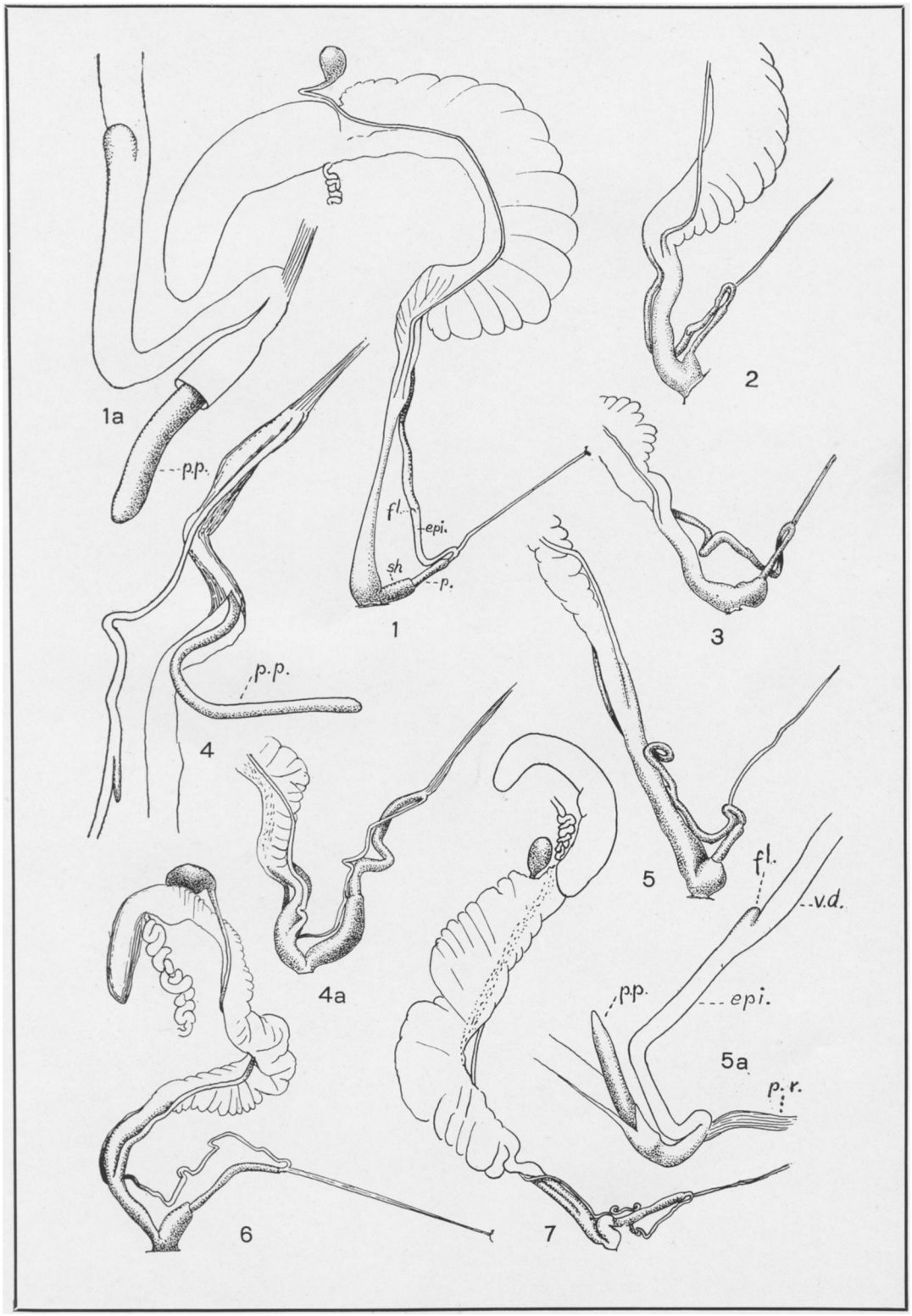

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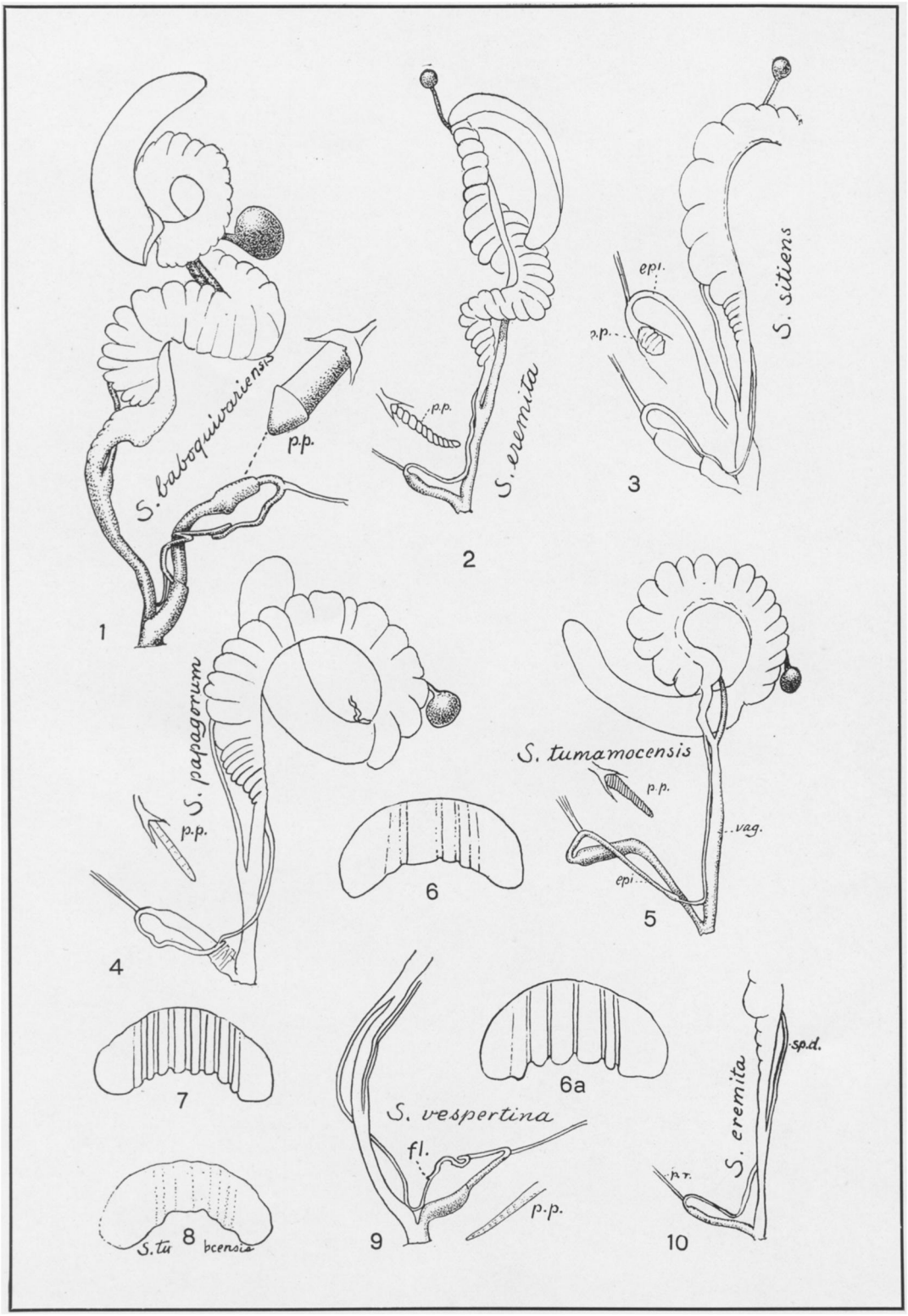

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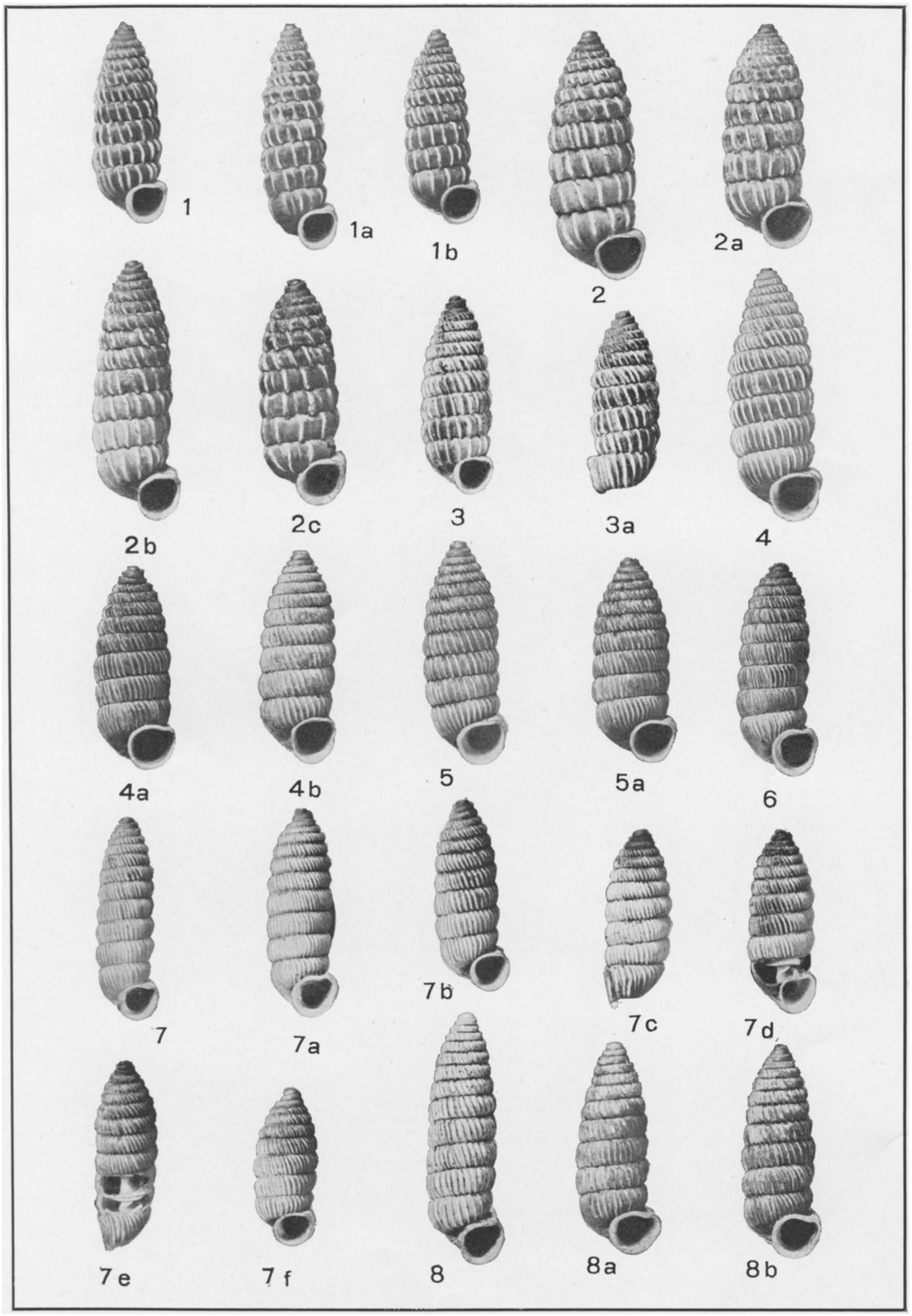

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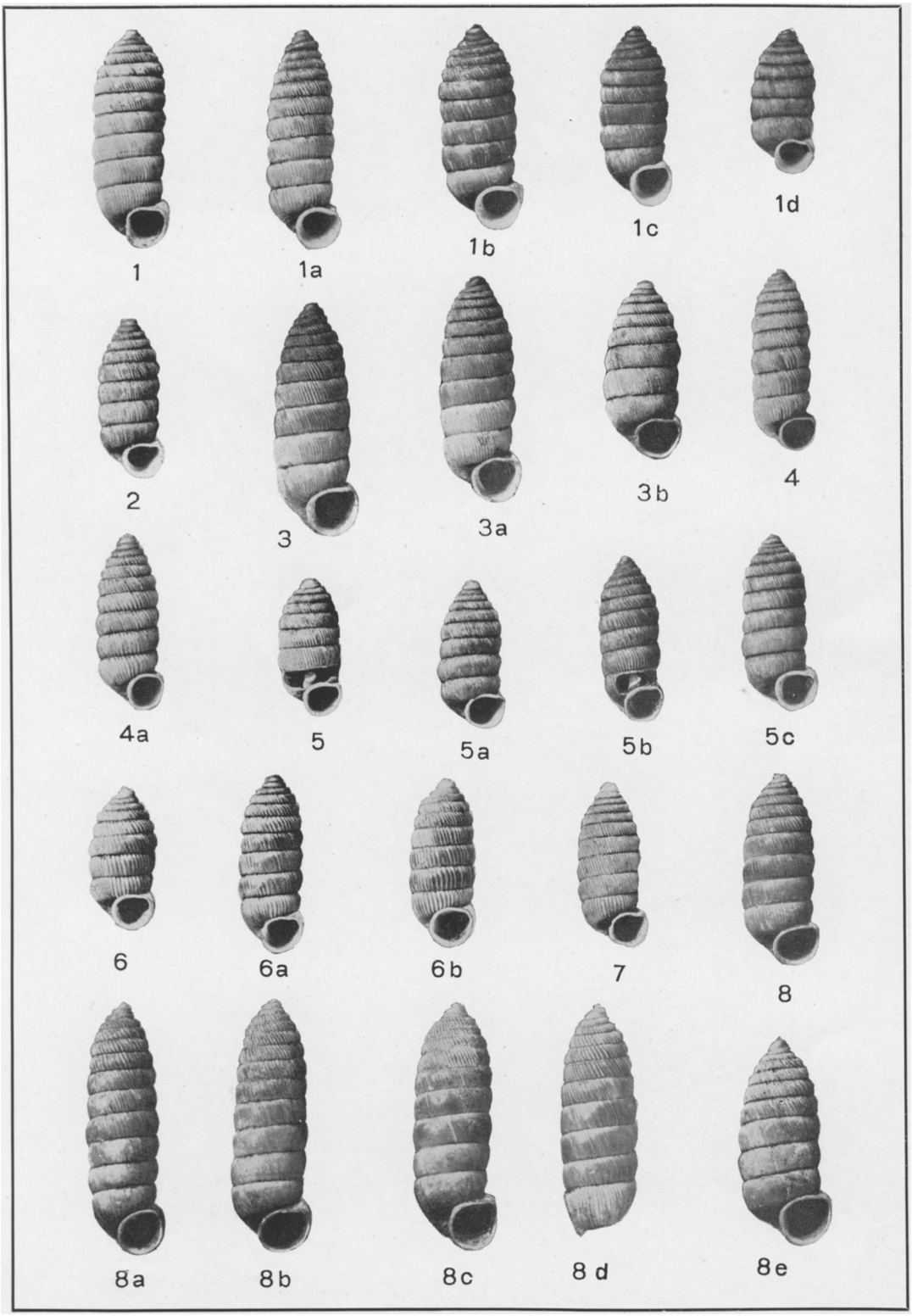

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